Rock Products

With which is Incorporated CEMENT and ENGINEERING NEWS

Founded 1896

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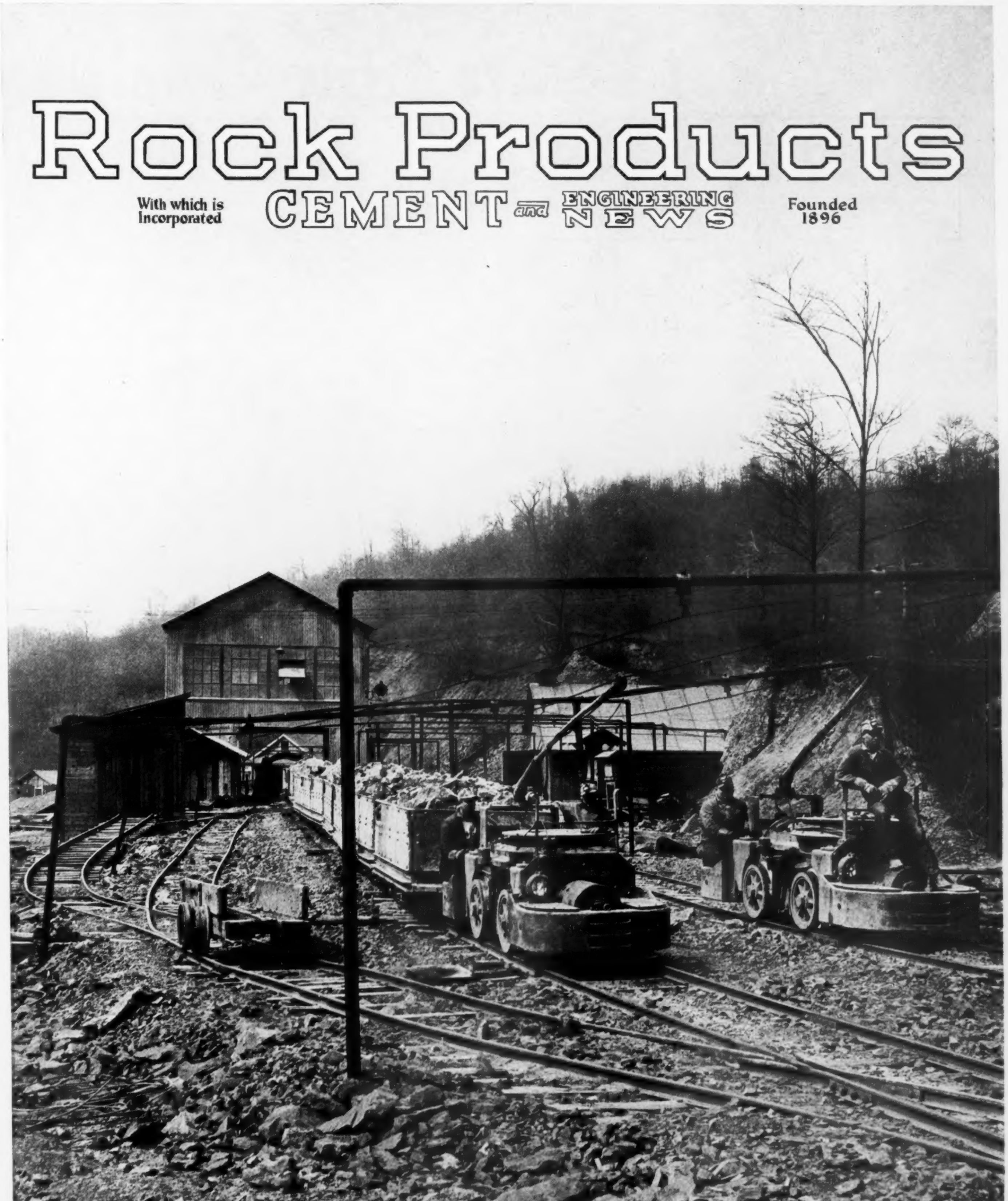
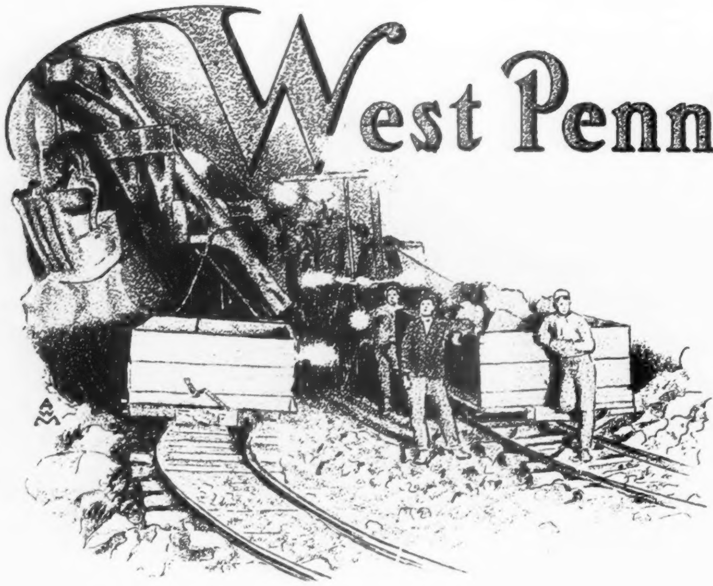


Storage tracks from mine and crushing plant of the West Penn Cement Co., West Winfield, Penn.; the 7-ton electric locomotives haul 6 and 7 cars of 135-cu. ft. capacity each



West Penn's Mine, Crushing

West Winfield, Penn., Operation Is Completely Electrified—New Crushing Plant and Enlarged Cement Mill—World's Largest Diameter Kiln

By George M. Earnshaw

IN OUR DESCRIPTION of the cement plant of the West Penn Cement Co., West Winfield, Penn., (near Butler) in the July 9, 1927, issue of ROCK PRODUCTS, we did not attempt to describe the limestone mine because it was just then being re-equipped and in general was undergoing many changes. Since then the mine has been thoroughly overhauled and outfitted with modern equipment and a new crushing plant has been built and put into operation.

The Mine

West Penn's mine is reputed to be the oldest limestone mine in this country, having been operated for almost 50 years. But this doesn't mean that it is near to being worked out, for the company's estimate is that there are sufficient raw materials yet remaining for more than 100 years of normal cement plant operation. The deposit was originally worked by the quarrying method but was converted to a mining operation when the overburden became too excessive for profitable quarry operation.

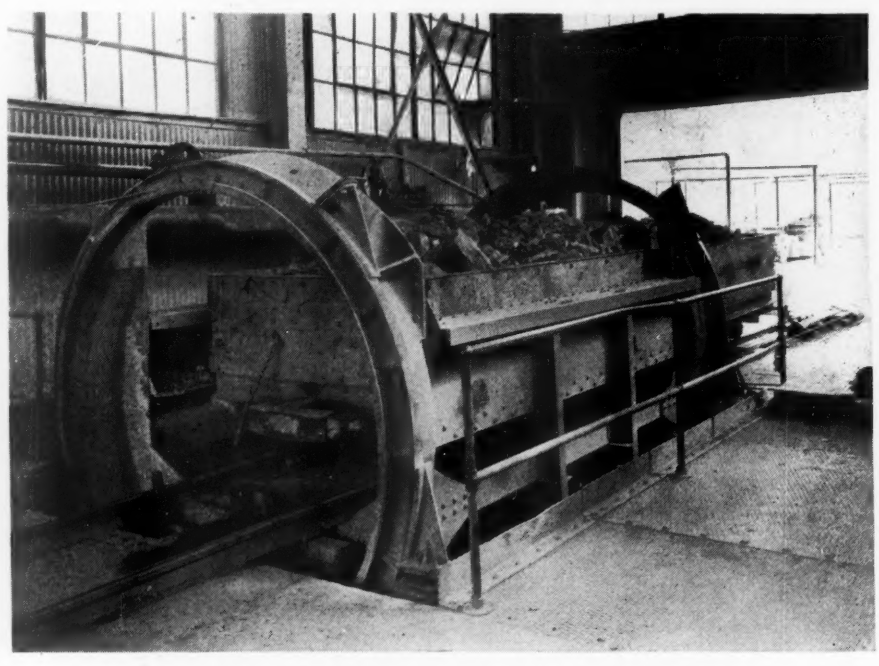
A typical cross-section of the property shows a 40 to 45 ft. stratum of sandstone, then a layer of fireclay, a 42-in. vein of coal, a 15-ft. stratum of clayey shale and then a 22 to 25-ft. stratum of limestone, known as the Vanport Series, lying almost parallel to the surface. Overyling the limestone are strata of shale, coal and sandstone. Thus the company obtains not only its stone, but shale and coal from the one mine.

The mine consists of tunnels, 25 ft. wide, from which rooms open alternately on both sides, on 60-ft. centers. The rooms are 35 ft. wide, an average of 20 ft. high, and the pillars, 25 ft. wide. Drilling is done by hammer drills, on tripods, by the breast-stoping method. The drilling equipment consists of 8 Gardner-Denver drifters; 3 Gilman drifters; 1 Chicago Pneumatic drifter; 2 Gardner-Denver and 1 Ingersoll-Rand stopers and 3 Ingersoll-Rand, 1 Chicago Pneumatic and 1 Gardner-Denver block-hole drills. Drill sharpening equipment includes a Model 8 Gardner-Denver drill sharpener on which is mounted a Model 10 hole-puncher. All the drills are fitted with LO-3A Gardner-Denver line oilers. Round 1¼-in. hollow drill steel is used and a set of six lengths will drill an average of three 12-ft. holes. The average drilling speed is 5 in. per minute.

Loading and haulage equipment consists of a Marion Type 7, all electric, 1-yd. shovel, on crawler treads; a Marion Type 450, all electric shovel, with crawler treads and 1¼-yd. bucket; a ⅝-yd. Thew shovel on crawler treads and 3 Butler air shovels with ¼-yd. buckets, operating on rails. The latter are used for auxiliary loading, cleaning up, etc.

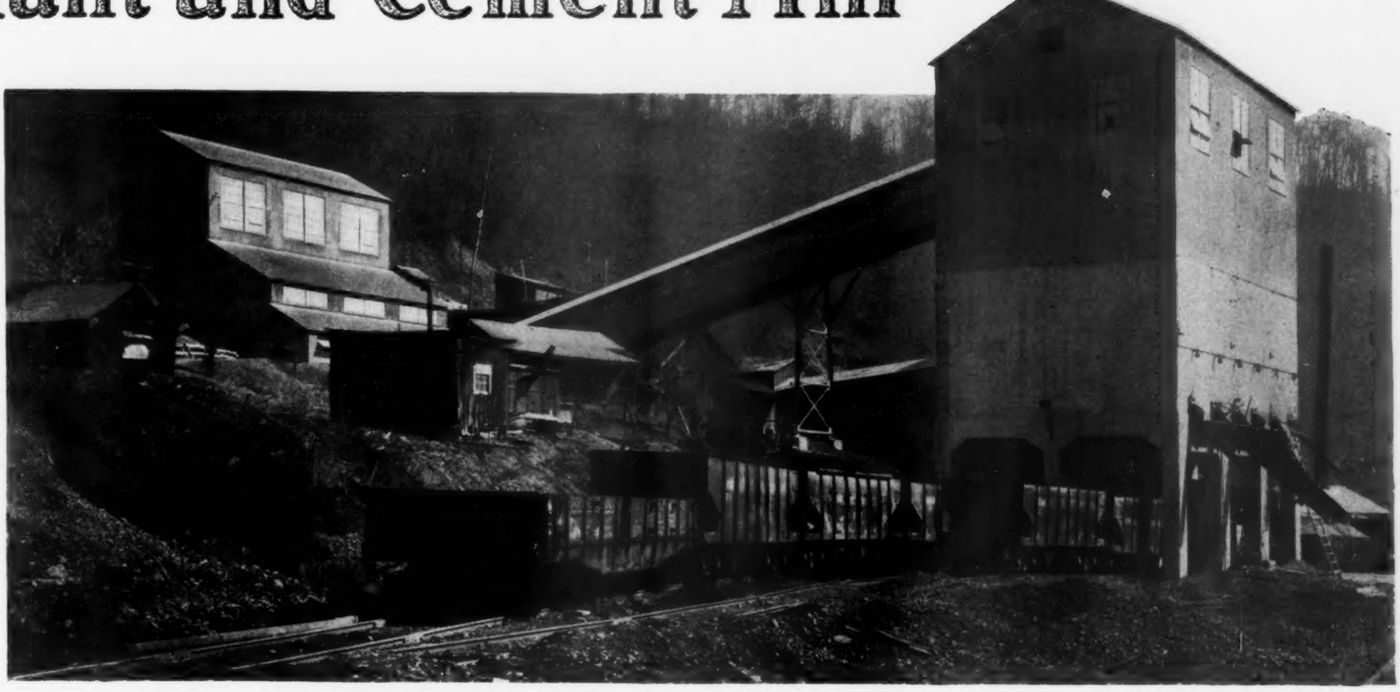
The cars, of which there are 75, are of a special design, built to West Penn's own specifications. They are of 135 cu. ft. capacity, are of steel and wood construction, and are equipped with Hyatt roller bearings and Alemite lubrication system. They are fitted with swivel couplings and 4-wheel, band-type brakes with take-ups. Fifty of the cars were built and furnished by the Hockensmith Wheel and Mine Car Co.; the remainder by the American Car and Foundry Co. Three 7-ton Ironton, double-motored trolley locomotives take care of the haulage between the mine and crushing plant.

Power, purchased from the West Penn Power Co., is received at the mine at 2300 volts. A General Electric 150-kw. motor generator set converts the power to direct current at 220 volts for serving the locomotives, shovels, fans and lighting system. Air for the small shovels and drilling is supplied by a 1350 cu. ft. capacity Bury compressor, direct-driven by a 225-hp. General-Electric synchronous motor. Due to recent additional air requirements a second compressor



Rotary dumper handles mine cars without uncoupling

Plant and Cement Mill



Crushing and screening plant—12 bins of 150 tons each for crushed stone

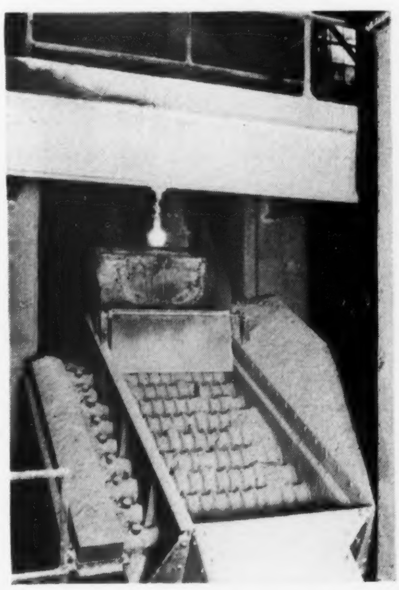
of the same size and make has been ordered and will be installed at an early date.

Crushing Plant

Considerable storage space is provided for loaded mine cars above the plant. The locomotives bring out trains of six or seven cars each and "spot" them on either of two storage tracks. From there the cars are pulled down to the crusher, a train at a time, by a home-made car-puller, consisting of a Mead-Morrison hoist and a series of sheaves arranged between the tracks. A car at a time is spotted on a Roberts and Schaeffer rotary car dumper; and as a train is dumped, it is "dropped" to the "empty" track below the crusher where a locomotive picks it up and returns to the mine through an entrance other than that from which it came out with loaded cars. This dumping and haulage system provides for cars and locomotives always moving in one direction.

The initial crusher is a 30-in. Traylor "Bulldog," belt-driven by a 150-hp. Allis-Chalmers motor. It is set to discharge at 4 in. and its product flows by gravity to a Stephens-Adamson live-roll grizzly with 2¾-in. openings. The oversize is elevated in a 24-in. Jeffrey chain-bucket elevator, driven by a 10-hp. motor through a James speed reducer. The elevator empties into a 10-in. "Bulldog" crusher, set to discharge at 2 in. The product of this crusher and that of the grizzly are moved by belt conveyor to the screening plant. The conveyor is of 325 ft. centers, 24 in. wide, is mounted on Robins, Hyatt, roller-bearing equipped idlers, with Alemite lubrication, and is driven by a 20-hp. motor.

The revolving screen is 72 in. in diameter, 26 ft. long and has two jackets. There are four sections to the main shell; the first three sections have 2¾-in. openings and the last one has 3½-in. openings. The first jacket is 17 ft. long, 15 ft. of which has 2-in. openings; the other 2 ft., 1½-in. The outer jacket is 15 ft. long and has ⅝-in. square holes its full length. The product of the outer jacket (minus ⅝ in.) is chuted to a 12-in. screw conveyor, 20 ft. long, which discharges through hand-operated gates to three 3- x 8-ft. Universal vibrating screens, each driven by a 3-hp. motor. These screens are fitted with ⅜-in. mesh cloth. The oversize from them is sold, for the most part, for road dressing, and the undersize, known as "buck-wheat" is sold for the manufacture of concrete products.



Live-roll grizzly scalps the primary crusher discharge

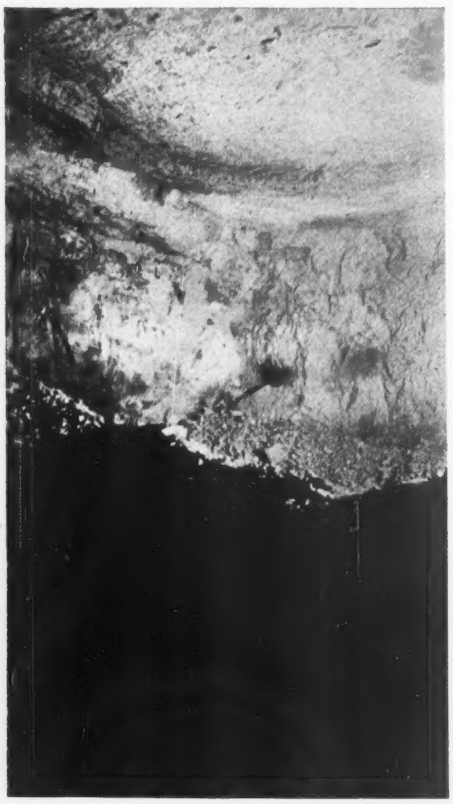
The material passing through the 2-in. screen is chuted to a fourth Universal vibrating screen where any number of special sizes are made.

There are two rows of concrete bins, six in each row, directly under the screens, the combined capacity of which is 1800 tons. The arrangement provides for loading a car on each side of two tracks simultaneously. While motor trucks can be loaded from side chutes.

The cement plant uses the minus 2¾-in. stone, which is loaded into the company's bottom-dump cars and hauled, about ⅓ mile, to the cement plant. The conveyor belt from the crushing plant to the screening plant is so arranged that it can discharge directly into the bins for shipment to the cement plant, without screening. Recently two additional vibrating screen washers have been installed to wash all sizes of stone before shipping. These washers are for removing stone dust only, as the stone is already cleaned of clay or soil.

The crushing and screening plants are of the most modern design and construction,

Mine interior, showing the 5/8-yd. shovel



Room in mine—curved layer near top marks limit of stratum mined

being of concrete and steel throughout. They are amply large to fill the cement plant's requirements and in addition, take care of the company's commercial stone business. The mine and plant are under the supervision of George A. Morrison, a mining engineer of long and wide experience.

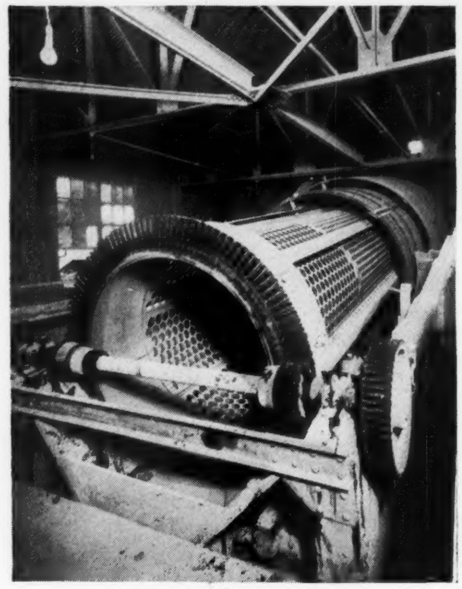
Many Additions in Cement Plant

Since Rock Products published a description of the West Penn cement plant nearly two years ago, general manager O. J. Binford has made many new and interesting additions and improvements in the plant. Chief of these was the installation, last fall, of a second kiln and cooler; two additional mills; another coal mill and dust-collecting equipment, including a system for collecting stack dust. At the present time, the company is changing the course of a creek which runs through the property, and relaying trackage about the plant, preparatory to building silos for an additional 20,000 bbl. of cement storage.

To our knowledge, the new kiln installed at this plant is the largest one in diameter ever installed in *any* cement plant. It is 11 ft. 6 in. and 15x 257 ft. The 15 ft. section is 42 ft. long and begins 37 ft. from the firing end. The enlarged section is not the clinkering zone but the calcining zone and is intended to produce a more perfect calcination and to afford a more uniform production than possible with standard-sized kilns. So far, the kiln has been run for experimental purposes. At present it is lined with standard firebrick of different makes.

The kiln was first put into operation on August 22, last year and since then has operated at an average of more than 2250 bbl. per running day. Ultimately, however, the company expects an output of 2500 bbl. per day. It has been proven by the operators that the kiln produces a grade of clinker, superior to that produced in the other kiln, which is 11 ft. 6 in. in diameter its full length. So far, coal consumption has averaged between 95 and 100 lb. per barrel of clinker.

The kiln's construction is of standard Allis-Chalmers Manufacturing Co. design. The enlarged section was assembled "on the job," as it would have been impossible to ship

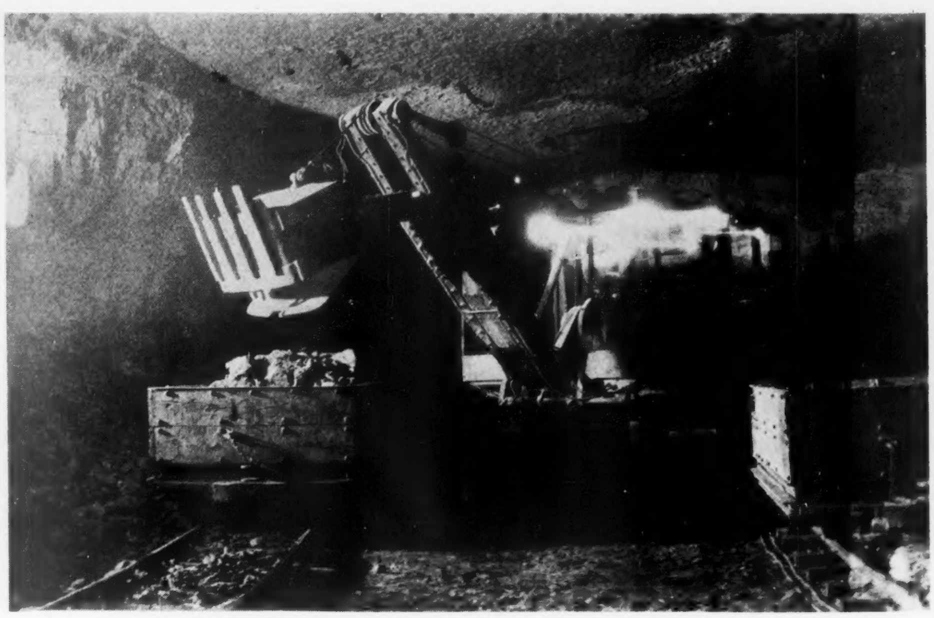


For normal operation this screen is fitted with plate sections having 2 3/4-in. holes, and practically all the product is used for making cement—Product of outer jacket goes to vibrating screens

such a large diameter shell by rail, due to lack of clearance on railroad bridges, in tunnels, etc. It is driven by a 125-hp. motor through gearing.

Unique Design Cooler

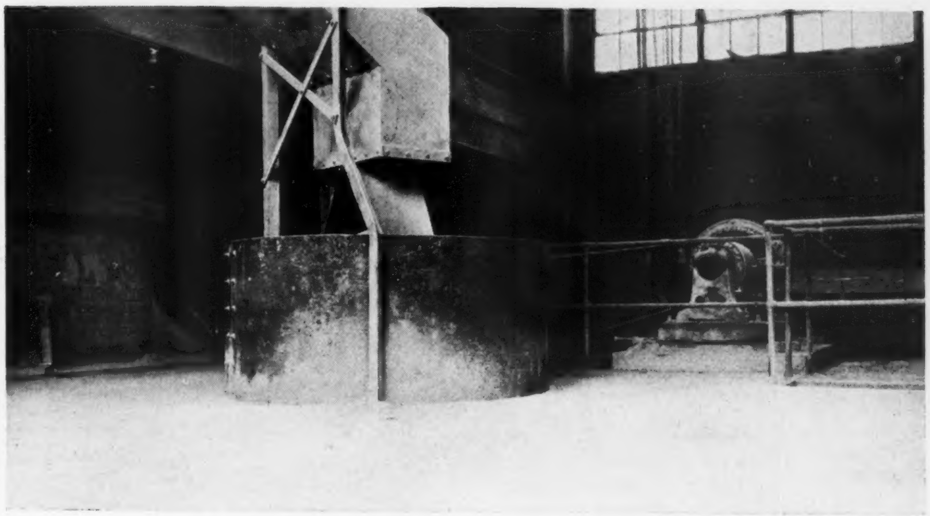
The cooler installed in connection with the kiln, is also unique in design. It is a 9 x 90 ft. shell, but the first 7½ ft. has an



Mine interior, showing the 1-yd. shovel

outside diameter of 12 ft. This 7½-ft. section consists of 20 buckets, or cavities, 18 in. deep, which pass through a water bath and in addition receive a water spray. This device was designed by Mr. Binford, primarily to offset the shortness of the cooler, which shortness was necessitated by the layout of the plant itself. (Ordinarily, a 9 x 90 ft. cooler is only large enough for 2000 bbl. per day.)

The interior of the next 25 ft. of the shell is fitted with alternately placed cast-iron plates and lifters. The remainder of the length is longitudinally divided into four sections by two S-shaped partitions. These are fitted with lifter plates so that the clinker is completely turned over four times in each section for every revolution of the cooler itself. Therefore, it affords 16 times as much movement of the clinker as does the cooler on the other kiln, which cooler is of a more or less conventional and standard design. This cooler discharges from the top into a chute to an Eichoff conveyor.



Primary and secondary crushers in crushing plant—note cleanliness

Kiln Dust Collector

One of the most important improvements in the plant is the installation of a complete dust-collecting system on the new kiln. This is a Davidson collector, installed by the American Blower Co., and is comparatively new in this county. It is a 78-in. machine, direct-connected to the kiln exhaust fan, which has a capacity of 135,000 cu. ft. per minute at 700 deg. F. Its operation consists merely of the production of a true cyclonic action, forcing the dust to the bottom and thence into a tank. As for the actual results obtained thus far, the dust losses from the kiln have been reduced to 5 tons per 24 hours while producing at the rate of 2250 bbl. per 24 hours.

In connection with the collector installation there is a 6-ton steel tank under the collector, from which the dust feeds to a 9-in. screw conveyor. This conveyor carries the dust to a 6-ft. diameter by 3 ft., 6 in. high agitator, furnished by the New England Tank and Tower Co., Everett, Mass. The agitator is driven by a 2-hp. Allis-Chalmers motor through a James speed reducer. The overflow goes directly to a 1-in. Wilfley pump which pumps directly to the kiln.

Unusually Large Mills

Two new Allis-Chalmers mills have been installed, one each for raw and finish grinding. They are 9½ and 8 x 38 ft., each driven by an 1100-hp. Allis-Chalmers motor through a 78-in. Cutler-Hammer magnetic clutch. Some idea of the size of these mills can be had from the fact that each of them weighs 92 tons and carries a charge of 90 tons of grinding media. As far as known

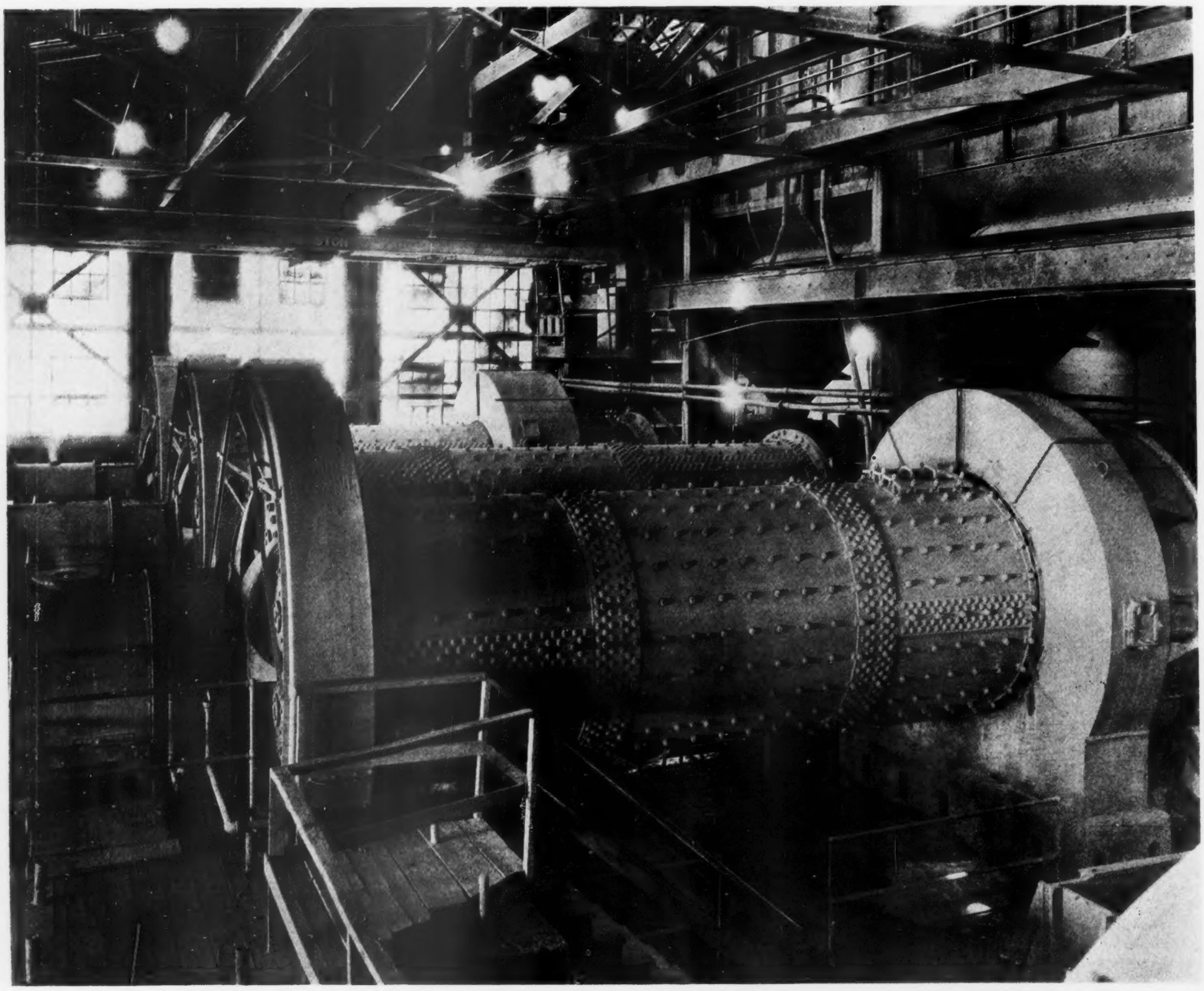
Close-up of one of the four roller bearing rolls (guards removed) which carry the feed end of the 9 1/2 x 8 x 38 ft. raw grinding mill

they are the first mills of their kind to be mounted on roller bearings.

The two carrying rollers at the head end of each mill are 48 in. in diameter, with 24-in. face, each mounted on two Timken roller bearings. These bearings are of 16-in. bore, 26½-in. outside daimeter, and are fitted with Alemite lubrication. It is estimated that each bearing carriers a load of approximately 60,000 lb.

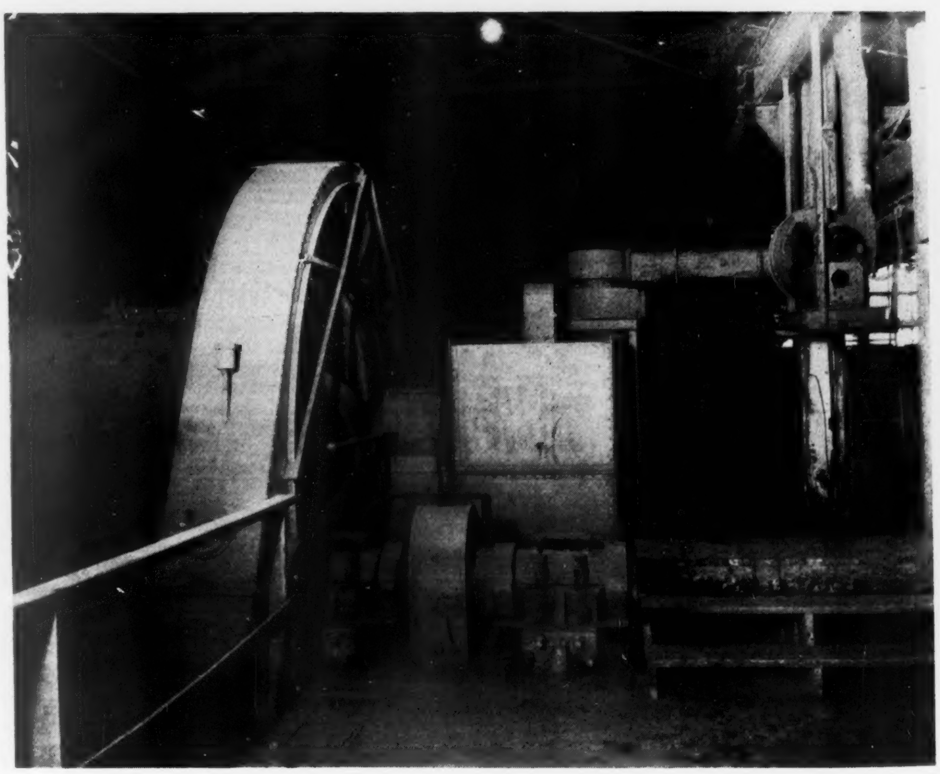
So far, the operation of the mills has been in the experimental stage. The average production has been 200 to 230 bbl. per hour grinding to a fineness of 86 to 87% minus

Material smaller than 5/8-in. is graded in this battery of vibrating screens and is sold for highway work and cement products manufacture



ABOVE—General view of mill room; mill in foreground is one of the new 9 1/2 x 8 x 38-ft. grindng units; the two in the background are 8 x 30 ft.

TO RIGHT—Close-up of discharge end of new mill, showing new type of dust collector installed



200-mesh in the dry mill and 125 bbl. in the wet one. This production is satisfactory to the management, for the 8x30 raw mill, previously installed, produces an average of 75 bbl. per hour and the finish grinding mill, of the same size, has averaged 120 bbl.

The finish grinding mill is equipped with a 10-in. Davidson dust collector. It is designed to create just enough draft to clean up the ends of the mill.

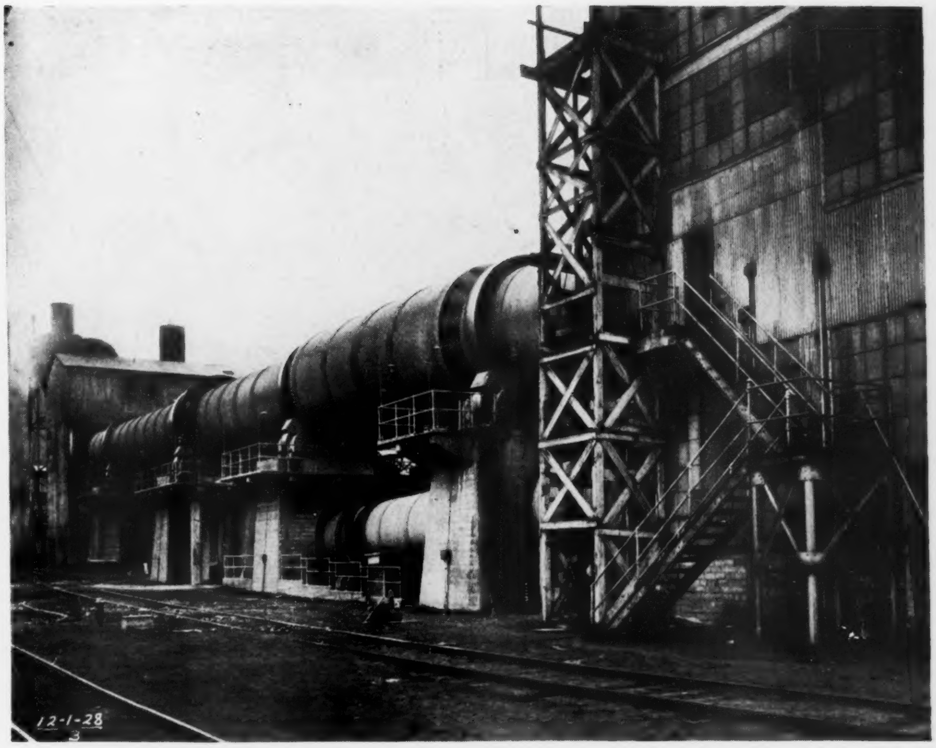
Oversize Coal Mill

At the time of installation of the kiln was also installed a giant coal grinding mill. It is a 70-in. Fuller-Lehigh machine of the improved type, direct-connected to a 250-hp. Allis-Chalmers motor. It has averaged a production of 10 tons per hour at a fineness of 78% to 80% through 200-mesh. Its production figure is comparable with

4½ tons per hour, at the same fineness, from the 46-in. mills of the same make and type which the company operates. A large Randolph dryer, also furnished by Fuller-Lehigh, was installed at the same time as the new mill. The coal mill, like the finish-grinding mill, is equipped with a Davidson dust collector.

In spite of so many new and unique features, there is nothing elaborate or extravagant about the plant, for after all, it bespeaks simplicity throughout. It is easy to see, when going through the plant, that every dollar spent in the plant was intended to reflect itself in low-cost production.

O. J. Binford is general manager; A. E. Hiscox, superintendent and chemist; W. W. Binford, engineer; Claude Eshbaugh, master mechanic; George A. Morrison, mining engineer, and F. C. McKee is sales manager. These are the men directly responsible for the building and operation of the plant and its allied operations.

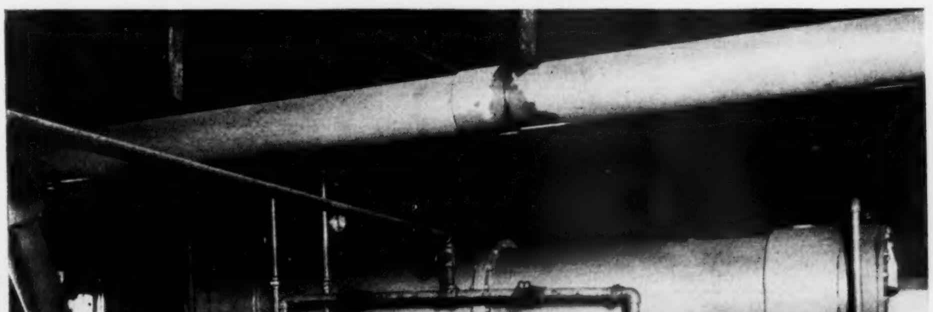


New 11-ft. 6-in. by 15-ft. by 250-ft. kiln with a 9 x 90-ft. cooler at the plant of the West Penn Cement Co. near Butler, Penn.

Design and Control of Concrete Mixtures

A READING of the third edition of "Design and Control of Concrete Mixtures," published by the Portland Cement Association, shows that there has been considerable editing and revision of the original publication to bring it up to date. Even those who are familiar enough with the subject will find the bulletin interesting reading, for it is astonishing how much of the theory and practice of concrete making has been explained in its 72 pages, 26 of which are given to specifications and standard methods of testing.

The bulletin is also an example of the way technical engineering subjects may be explained in words that everyone understands, without losing exactness of meaning. As an example, take the definition of aggregate: "Aggregate is an inert mineral filler used with the water-cement paste for economy." It would be hard, if not impossible, to improve on this. And the whole theory of concrete mix design is given in this sentence: "Designing a concrete mix consists in selecting the water-cement ratio which will produce concrete of the desired strength and resistance to exposure and finding the most suitable combination of aggregates which will give the necessary workability when mixed with cement and water in this ratio."



Air-compressor installation at West Penn plant

Naturally the greater part of the text is given to the proportioning of materials and the things that affect proportioning, such as bulking and absorption. It is notable that the method of proportioning by mixing aggregates to a given fineness modulus is not given because, "The method involves tests and calculations which must be made in the field, often under very unfavorable conditions." The trial method is recommended "because it is practical, easy to apply, and produces the results desired." The absolute volume method of finding the quantities of materials needed for a given proportioning is given in sufficient detail to be easily understood.

Regarding materials, nothing is said about cement, of course, but a great deal is said about aggregates. The tentative specification for aggregates adopted last year by the American Society for Testing Materials is called a good specification and given in full. Visual inspection, it is said, will usually disclose any weakness in the aggregate, and a test in concrete specimens is recommended if there is any doubt about its quality. Good sales ammunition for the producer of clean aggregates is found in the short paragraph discussing dirty aggregates.

Appraisals Necessary for Mergers—Present Worth

W. Malcolm Loury
Henrici-Lowry Engineering Co., Kansas City, Mo.

THE WORD EFFICIENCY has been used in all possible applications and under so many circumstances that the general public has grown critical and we now realize that "faith without works is dead," and that all is not efficiency that claims to be. However, from the impetus given to general business because of the emphasis placed on efficiency much benefit has resulted; and like other passing popular appeals the efficiency movement has not failed to be both helpful and constructive in many instances.

Mergers and consolidations have been prevalent in the last few months and they have come about through the knowledge of efficient methods of operation and a necessity caused by keen competition.

Manufacturing and producing companies that have no common financial interests have joined in co-operative advertising campaigns, thus parading their several similar products before the public, but each concern has conducted its own sales organization. Public utilities, particularly, have offered an attractive field for consolidation and centralized management.

Other industries have developed plans that help to stabilize production and output within certain trade territories, but do not combine their plant organizations.

Then has followed the actual merging or consolidating of individual plants. These combinations have been completed by revamping the output in some, or by the entire elimination of others from the production field, with sound economical reasons behind either move.

These mechanical combinations are the ones that are of great interest to the bond or stock-buying public at this time. They also affect the commodity buyer, and must demonstrate an improved product at a satisfactory price or meet with serious public opposition.

Evaluating Plants in Mergers

Our office has been called upon to evaluate the properties of several large groups which were contemplating a merger and which have since completed their consolidation. At the present time, we are making a comparative study of values and working on a merger that will bring together eighty plants and may entirely revolutionize, both in product and in prize, the industry they represent.

Who co-operates in a contemplated merger?

The appraisal engineers are confronted with the problem of determining the values and economic worth.

The accountants are expected to examine the financial responsibility of each participating unit in its relation to the whole, and to analyze the general set up. Their economists must provide for depreciation in some manner. To be properly compared with others, each department should have its cost records prepared in detail.

The legal department must examine deeds, leases, contracts and general instruments of property rights, together with contemplated deeds of trust.

The financial interests must set forth the earnings and arrange a redemption schedule.

What do appraisal engineers do?

They must determine the nature and location of the raw material and its cost per unit of recovery.

If the plant is dependent upon a deposit of natural resources, that deposit must be explored and charted.

The availability of water and fuel supplies must be investigated.

Housing conditions must be determined in relation to the needs for expansion.

The nature of the operation must be scrutinized and a flow sheet prepared.

The output of all plants must be compared on the basis of the new operating conditions and also with reference to the centralized management.

The engineer should examine what?

Some of the factors that must be considered in compiling an appraisal on properties that are contemplating a merger follow:

Are the plants:

In the same trade territory and subject to the same freight-rate tariffs?

Identical throughout in their products and sales opportunity?

Making products which fall within seasonable markets?

Now overlapping in operation or duplications of other plants?

Affiliated with other industries that would be vitally affected by a merger?

Working to a reasonable rate of production?

Using largely the same methods of production and are their products standard?

Able to be operated from a central point with a smaller personnel?

Then the questions follow:

Would lower operation costs be secured by eliminating certain plants and condensing production within others?

What would be the effect on the general financing of the group due to special conditions applying to certain of the smaller plants?

Would better products be secured by exchanging equipment within the group plants?

Would the market be able to absorb the full output?

Many other points naturally arise in each instance.

Why should the book value, replacement value and insurance value be considered?

The matter of book value need not be discussed here.

The replacement value on buildings, machinery and fixtures must be determined. It will be interesting to compare this figure with book values, because in many plants all costs for installation and freight have been charged off to operation and have therefore been lost to "capital account." In many accounting systems, the item showing the amount of investment necessary to go back into business has been entirely overlooked.

The depreciation factor should be applied to each item, based not alone upon age, but upon operating condition and performance in service. Oftentimes depreciation can be partially offset by appreciation, especially if the plant has been operating over many years, and has been carefully maintained.

Interesting contrasts are often encountered when comparing depreciated values secured by physical listing to the book values arrived at by ordinary bookkeeping methods. Few institutions would be willing to settle a fire loss upon their book values because the executives realize that such entries do not represent present worth or replacement values, especially if straight-line depreciation methods have been employed.

Fire insurance written on plants generally carries the co-insurance clause, and it is frequently discovered that this indemnity covers the book value and not the replacement cost, which is the most important item and the one to be protected. This naturally places a heavy penalty upon any loss settlement. If the insurance value is properly set up, many items of worth such as foundations, footings, excavation, etc., can be deducted and the annual premiums greatly reduced. These separate items are classified as non-insurable.

How should the appraisal be made?

The property of a merging company should be evaluated as a going concern and not regarded in the light of a forced sale.

The valuations should all be made to cover the same period of time.

The special apparatus, patterns and development equipment should be listed separately and carefully compared with standard equipment.

General Comments

The intangibles or overheads are matters that are frequently overlooked in contemplating a merger. These cover the items that are essential in creating the project and naturally become a part of the basic worth of the institution. These include architects and engineers' fees, insurance, interest paid during construction, contractors' profit, legal and financing expense and other items. A special listing of property not useful to the business is essential. An inventory of any manufactured stock or general supplies on hand should be compiled.

Years ago Webster's dictionary carried this definition: "An appraisal is an estimate of worth by persons appointed and qualified." The basic qualifications have not changed and these conditions still apply.

How does an appraiser substantiate his prices?

He must keep generous files on all matters pertaining to materials, machinery, freight rates, hauling charges and all classes of wages paid to craftsmen. Our office subscribes to many bureaus which supply current quotations and freight rates. Actual quotations are secured from the manufacturers of machinery and equipment.

We also design plants in their entirety, and when submitting our plans to various contractors and dealers for competitive bids, we secure authenticated quotations which can then be applied against similar items when compiling a valuation. These prices are worked into unit values and applied separately against quantities of material and the necessary amount of labor.

Are appraisal values ever disputed by others?

Occasionally a service company is hailed into court to establish the nature of its business and the amount of its investment.

In our capacity of appraisers, we are frequently called upon to testify before courts and commissions, on questions of investment and physical value.

This service is frequently rendered after a loss and in settlement of a fire or windstorm.

Courts welcome this information when hearing dissolution suits and when closing up estates.

The appraisal becomes of great importance to the court in case of a receivership and the necessary reclassification of individual properties.

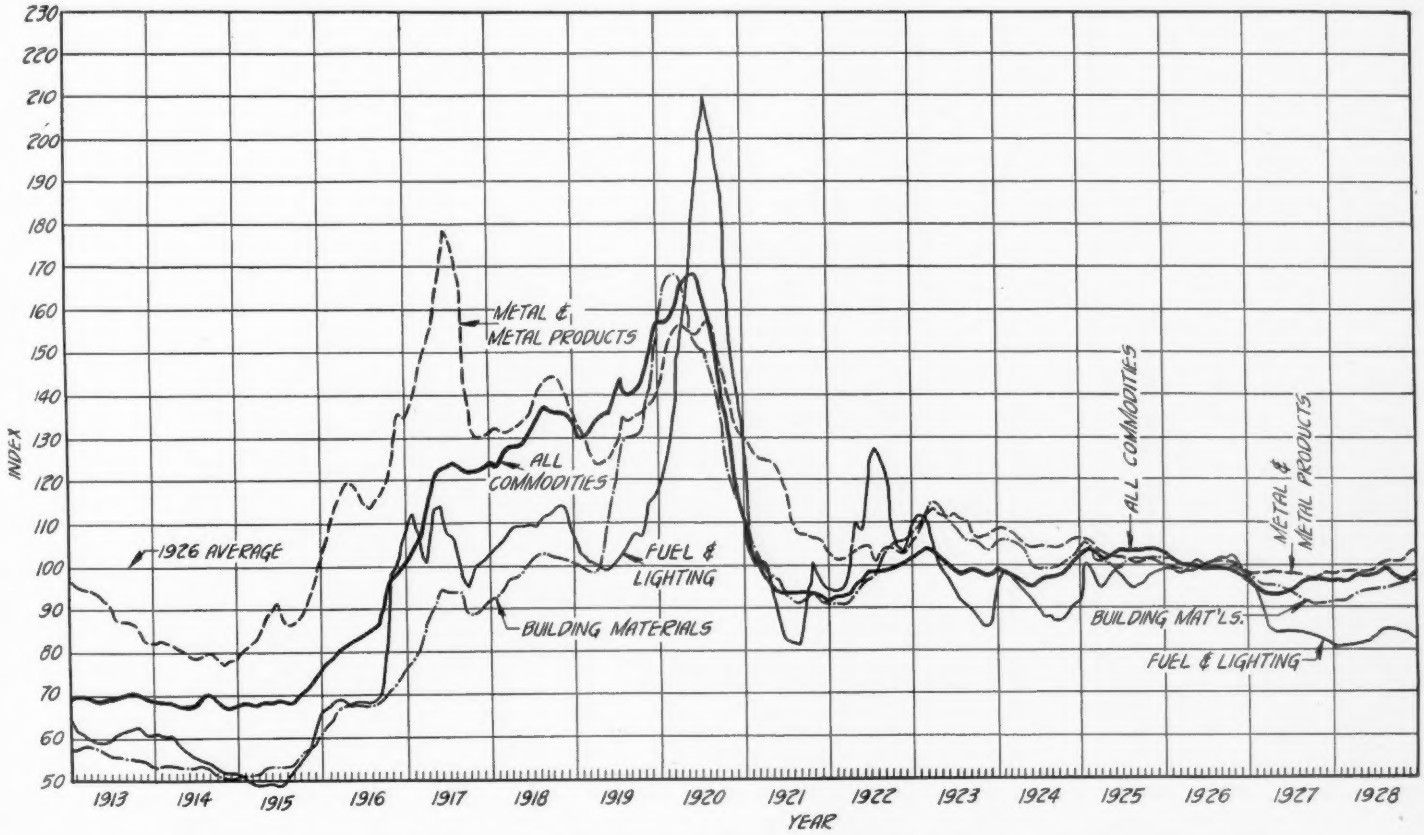
Are prices still changing?

In order to know how the present cost of various commodities will compare to its former value, graphic charts are maintained in our office showing price trend. Two interesting trend curves, based upon recently published data, are shown herewith. It will be noted that the base line value will soon change from 1913 to 1926 as that is the point at which the cost curve begins to flatten out.

These charts are divided into years and then further sub-divided into months.

The first chart shows a composite grouping of many commodities and the heavy line shows the average quotation. The second chart shows the fluctuations on special materials and follows the same sub-divisions.

These charts are based on normal quotations and are not intended to include freight or special expenses due to locality.



Wholesale price comparisons, compiled from government data by Henrici-Lowry, February, 1929

It will be noticed from these charts, that properties are greatly influenced by change in price base and should be evaluated at regular intervals.

The appraiser should make examinations by applying the same yard stick of measurement to all properties within the group. The essential factors are thereby determined and the final figure sets forth its worth in relation to the other properties with which it is to be associated.

Importance of Knowing Actual Worth

Frequently such examination will automatically eliminate certain properties from the proposed group.

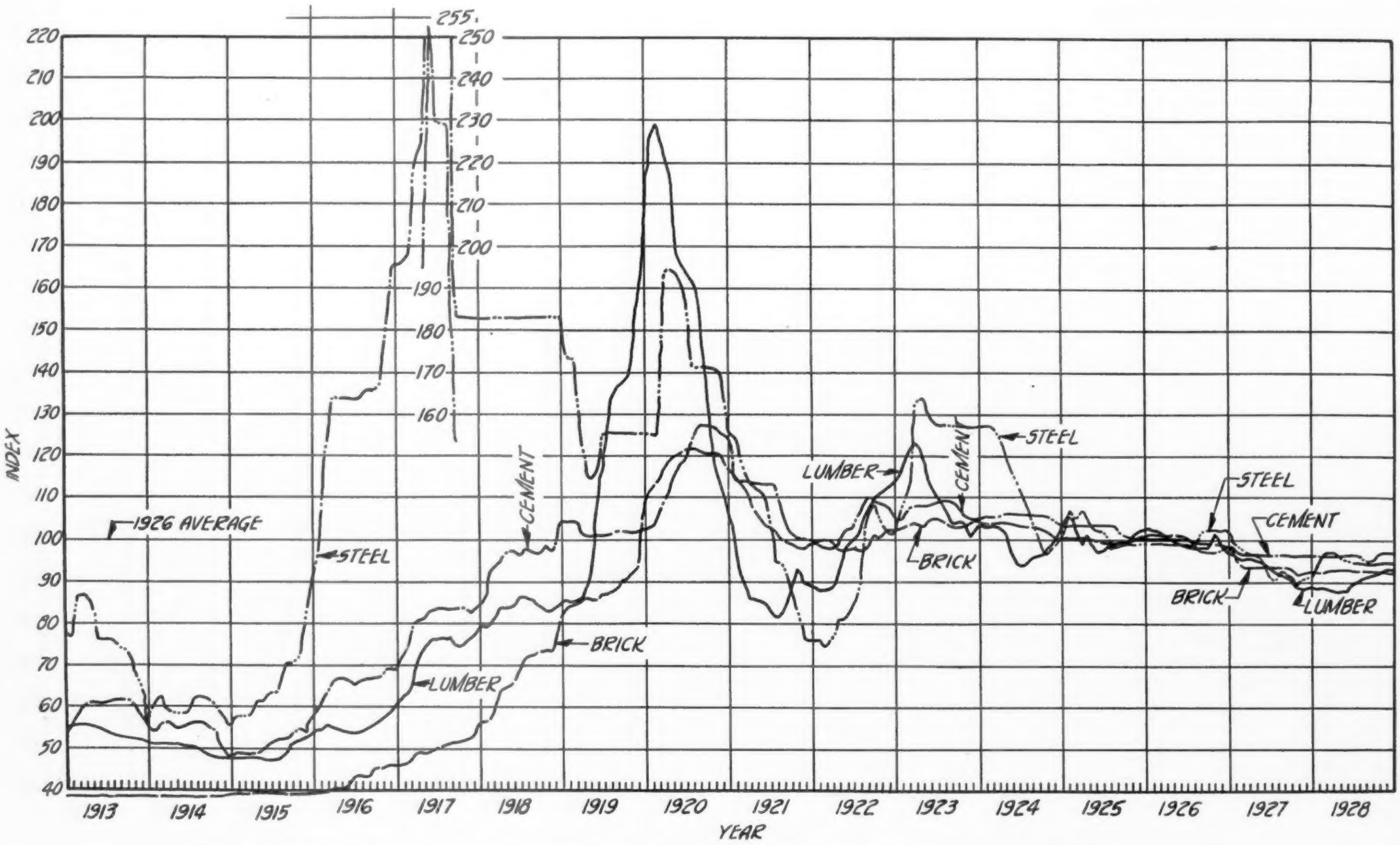
The public is daily becoming more familiar with mergers and will be satisfied with them only as long as they profit by their successful and economical operation.

It behooves the operator and the financier

therefore, to see that the original merger structure is founded upon actual worth and that the future of the industry is safeguarded by a careful analysis of the diet fed to the new creature to prevent its receiving plants or values which cannot be assimilated.

The life insurance companies have taught us much about expectancy; and the use of proper engineering services at the time of consolidation, will do much toward starting the new company along its road to ultimate achievement and the giving of satisfactory and economical service to the buying public. A merger should be consummated only if the life expectancy is above normal.

A valuation compiled upon scientific principles, should be the basis for all consolidations.



Wholesale price comparisons, compiled from government data by Henrici-Lowry, February, 1929

Gypsum Industry Developing in Australia

AUSTRALIA possesses abundant supplies of gypsum to meet her requirements for many years to come with deposits of commercial value being exploited in all states except Queensland and Tasmania. In these two states it is very likely that the mineral occurs in substantial quantities in remote localities. New South Wales and Victoria together produce 15,000 tons a year. The western Australian production is increasing owing to the demand for the material for fertilizing purposes, although the present annual production is only between 4000 and 5500 tons. South Australia, however, is the principal center of the industry in the commonwealth. This state produces 85,000 tons per annum, or three-fourths of the Australian output.

Deposits of gypsum are widely distributed throughout south Australia, and many are of exceptional size and purity. They are of various types, some occurring as "flour gypsum" or gypsite, others as "seed" gypsum and others as "rock," or crystalline gypsum. The material occurs in such quantities and can be so cheaply mined, owing to the absence of appreciable overburden, that the governing factor—apart from quality—is transportation from the deposit to the market. For this reason the deposits that are extensively worked are all close to the coast. Other deposits used for agricultural purposes only are worked close to the point at which the gypsum is used. The largest deposits are located along the seaboard of the great Australian bight. On Yorke peninsula there are massive outcrops of seed gypsum flanking the shores of the innumerable salt lakes. The beaches of the lakes are often entirely composed of gypsum rock many feet deep.

The gypsum from these deposits finds its way all over Australasia. In its unaltered state it is used in cement manufacture for the prevention of too rapid setting in the irrigation areas, to prevent the formation of black alkali (sodium carbonate), as a flux in the smelting of New Caledonian silicate nickel ores, and to a slight extent in lead and copper smelting. The plaster of Paris industry absorbs the greatest proportion. Factories owned by three companies—the Austral Plaster Co., the Peninsula Plaster Co. and Australian Gypsum, Ltd.—are at present in operation. They are well equipped and are run on scientific lines. With the natural advantages that Australia possesses there seems little doubt that markets will be found for its gypsum and gypsum products in South Africa and Asia in the not far distant future.

Portland Cement Association Issues Booklet on Concrete Bridges

THE PORTLAND CEMENT ASSOCIATION, Chicago, has published an attractive and well illustrated booklet, "Concrete Bridges," for distribution among engineers, civic and town councils and chambers of commerce where bridge construction is under consideration.

The booklet presents a discussion of some of the principal requirements of bridges, and how these may be met economically and efficiently. Maintenance, economy and structural details of incidental parts as well as a plain discussion of the material "concrete" and the factors relative to its successful manufacture are among the subjects treated. The illustrations have been chosen to show the possibilities of concrete for bridges of any length or for single spans of from 20 to 300 ft. and longer.

A Mica Recovery Process That May Have An Application in Sand and Gravel Industry

By H. J. Bryson
State Geologist, Asheville, N. C.

DURING THE PAST YEAR a new process for the recovery of mica from kaolin clays was established at many of the clay-washing plants in the western part of North Carolina. The process has proved to be very successful and the profits derived therefrom have been far beyond the expectations of those installing the necessary equipment. Since it has proved to be practicable as well as profitable in this particular industry many sand and gravel producers throughout the south have thought that the same or a similar process could be applied to freeing mica from sand and gravel. Mica is a very undesirable constituent in certain sands and gravels as well as in kaolin clays, therefore, research along these lines should be undertaken.

The practicable application of new processes depends on two important factors; first, local conditions and, second, marketing of finished product. These factors, as applied to this particular process, may be discussed briefly here. The factors effecting local conditions are controlled by nature and can be altered little by man. The most important factors, in order of importance, are extent of deposit, percentages of various constituents, topography, water supply and transportation facilities.

For a mineral deposit to be commercially important, it must be large enough to supply a product for a number of years otherwise the cost for the construction of a plant will not be recovered. In North Carolina, there are numerous deposits which are too small to warrant the erection of a plant. Enough prospecting should be done either by digging pits and tunnels or by drilling to block out the tonnage. Many times too small a deposit caused the failure of a company. The percentage of marketable mica recoverable should be from 2% to 10% of the material handled. This of course depends on how easily the mica may be recovered or the number of steps through which it goes.

Topography also influences the cost of the extraction of mica, first, because of the cost to raise the material high enough to go through the plant and, second, the cost to dispose of the tailings (see Fig. 4). If a plant is built at a lower elevation than the deposit and the hydraulic method of mining is used, the material will go to the plant by gravity, otherwise, a bucket elevator and troughs will have to be used. Also the tailings will have to be disposed by a conveyor if the land is of low relief.

The water supply is also an important factor in the mica recovery process. There must be a large continuous supply especially if the hydraulic method of mining is used. A large amount of water is used throughout the process to prevent clogging in the disintegrator, on the tables and in the screens. If there is very much clay in the deposit which will not dissolve readily, there is a general tendency for the material to ball as well as to clog the machinery. The entire process is continuous consequently a steady flow must be assured at all times. At the plants built to recover mica from kaolin as long as the flow is steady and rapid everything runs smoothly, but as soon as the flow becomes intermittent or slows down there is a tendency of the heavier materials to settle out and to pack. Thus trouble is en-

Fig. 1. Kaolin clay pit—note size as compared to man in bottom of pit

Fig. 2. Bucket elevator carrying material from trough

countered along the entire line.

Value of Mica Recovered

Many good and valuable deposits of mica cannot be worked due to the lack of adequate and cheap transportation. However, if all the other factors are favorable, one is justified sometimes in constructing roads, tramways or narrow gage railroads from the standard gage railroads to the deposits. This justification can only be determined after a thorough investigation of all other factors is made.

The finished product of any plant must be of such purity as to be desired by the various trades. The qualities most desirable by the various trades consuming mica, namely, the manufacturers of wall paper, tar roofing, automobile tires and tubes, insulating material, and lubricants, are uniformity of size of flakes, freedom from grit, especially quartz, and to some extent brilliancy. Brilliancy is especially desired by the manufacturers of wall paper and Christmas tree decorations. The objectionable materials which may be found associated with mica are quartz, undecomposed feldspar, garnets, and clay. The clay is usually eliminated by thorough washing. However, the mica that contains clay between the laminations cannot be washed and is therefore unsuited to many of the trades. Iron stained mica is also undesirable in the manufacture of wall paper and Christmas tree decorations but not so objectionable in the rubber tire industry.

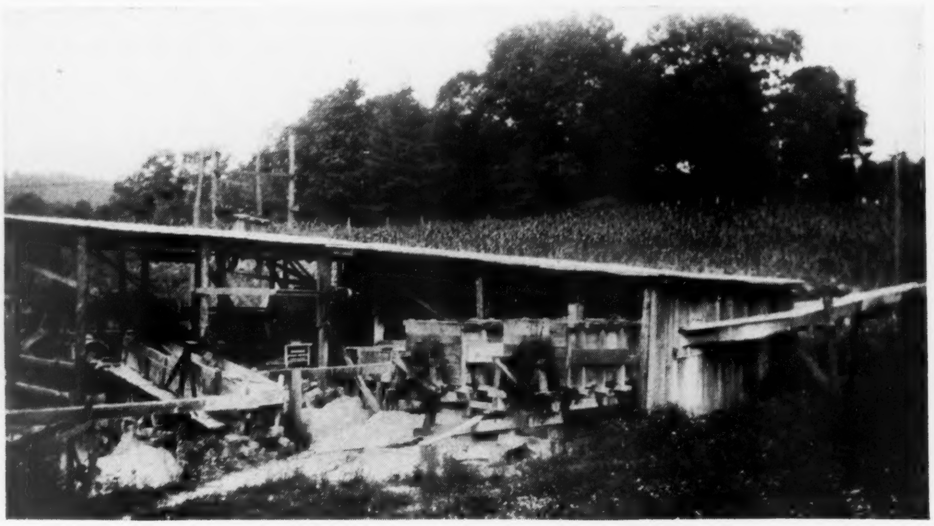


Fig. 3. First unit of plant which includes disintegrators, chain classifier, hexagonal screens and one concentrating table

Possibilities of Application to Sand and Gravel Industry

The mica recovery process discussed below is that which is applied to mica occurring in kaolin clays. However, with certain minor changes the process might be applicable to mica occurring in sand and gravel deposits. The most important change would be the elimination of the Dorr bowl classifier because this machine is especially for the recovery of the high grade white clay occurring in decomposed pegmatites or coarse grained granites. It would not be needed for none of the clay or very fine sand recovered from sand and gravel deposits can be used commercially. The classifier is also one of the most expensive pieces of machinery used in mica or clay recovery process. However, it is one of the most important pieces used in the refining of the kaolin clays by the Norman G. Smith Co., Spruce Pine, N. C.

The kaolin or china clay from which the mica is recovered is of the residual type; that is, it is formed by the decomposition of feldspars and granites in situ. This type, when properly washed and cleaned, is the purest clay known, being almost pure kaolinite. The kaolins of the Piedmont sections of North and South Carolina and Georgia, as well as the Florida kaolins are of sedimentary origin which originated from the pegmatites and granites of the Southern Appalachian mountain region and later redeposited in the respective localities. North Carolina has long been the leading producer of kaolin clay of the residual type. This clay, when refined, is used chiefly in the manufacture of china, porcelain and semiporcelain ware, mosaic and other tile, spark plugs, and glass melting pots.

The clay deposits of North Carolina are found associated with the crystalline rocks, particularly in the mountain counties. The most important deposits worked at the pres-

Fig. 4. Chain classifier and elevator which disposes of waste material

ent time occur in a belt covering parts of Avery, Mitchell, Yancey, Buncombe, Haywood, Jackson, Swain and Macon Counties. Over one hundred mines and prospects are known in this belt. There is a total of seven clay washing plants operating in the above mentioned counties but only four of the plants have the mica recovery plants in operation along with the clay washing plants.

Freeing Clay of Mica

All of the clay deposits contain more or less mica, which is both the biotite and muscovite with muscovite predominating. The mica varies in size from minute flakes, which occur in the coarse granites, to small punch mica, which occurs in the true pegmatites. All sizes of mica are recovered by some of the plants while others recover only that which is finer than 20-mesh. Each plant recovers from 3 to 5 tons of marketable mica per day.

The mica recovery process as discussed here was worked out by H. H. Gaines of the Norman G. Smith Clay Co., Spruce Pine, N. C. A great number of experiments and tests covering a period of several months were carried out before the desired results were obtained from a commercial standpoint. Even after the equipment was installed, certain small changes had to be made, such as varying the speed of and the angle of inclination of the revolving screens, flow of water, inclinations of troughs and angle of the Deister-Overstrom diagonal deck concentrator tables. Other minor changes may be made in the future, but at the present time the entire process is quite satisfactory.

The old method of hydraulic mining is employed to bring down the mica and clay. from the clay pit (Fig. 1), which is at the present 100 ft. deep, the sludge is raised by abu cket elevator (Fig. 2) to the level of the ground, where the buckets empty into a trough which has about a 10% grade. This trough conveys the material to the first unit (Fig. 3) of the plant.

From the trough the sludge is sent through a beater or disintegrator (a sort of log washer—Fig. 3), in order to break the mica from the quartz or undecomposed feldspar which was not completely broken up in the trough. This disintegrator is 4 ft. square, 10 ft. in length with teeth 30 in. long, set on 8-in. centers and revolves at 275 r.p.m. A link-chain classifier carries out all of the quartz and undecomposed feldspar larger than 10-mesh. This coarse material goes to a waste dump. At one clay plant located in a flat a belt conveyor is being used to get rid of the coarse material (Fig. 4). This equipment is not necessary except where the ground is of low relief.

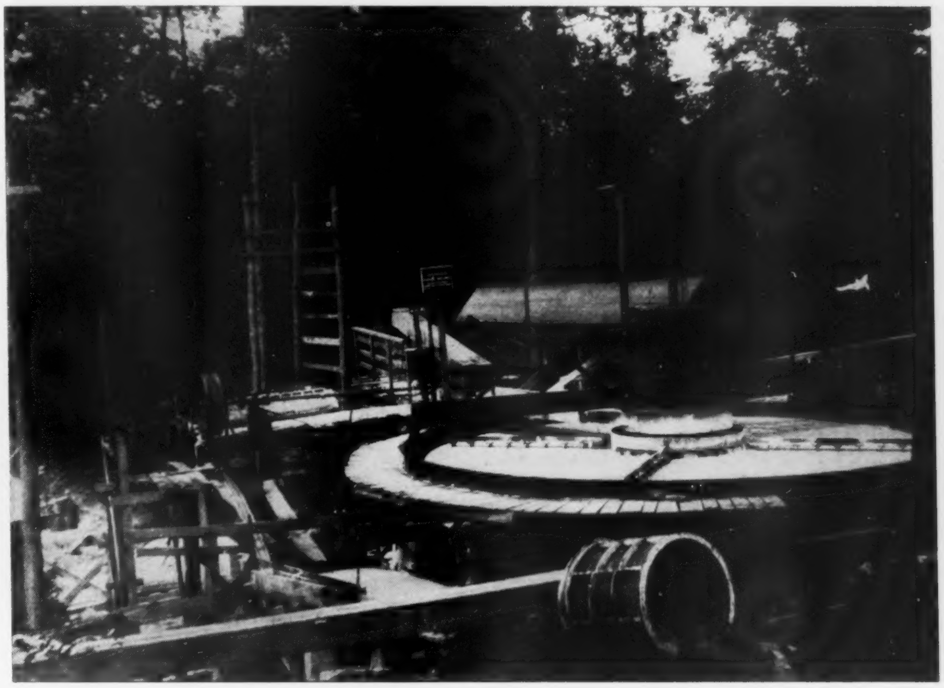


Fig. 5. Large Dorr bowl classifier. This unit is not needed except in process where high grade clay is wanted

From the disintegrator the mica is carried by water gravity trough to a Dorr simplex classifier. The tailings from this machine are minus 10-mesh, plus 40-mesh, while the product is minus 40-mesh, which goes to the large Dorr bowl classifier (Fig. 5). This classifier would not be necessary for a mica recovery process applied to sand and gravel deposits, as it is used to collect the fine pure white kaolin clay. It is, however, the most important step in the process applied to white clays. The tailings from the Dorr simplex classifier go to two 60-mesh hexagonal revolving screens (Fig. 6), which makes 17 r.p.m.

These screens are a very important step in the process. Several different types of screens were tried, but it was found that the hexagonal type, set at an angle of 5 deg. from the horizontal, was the most satisfactory. The water and clay enter the screen at the higher end. These screens have never given trouble by clogging. From these screens the minus 60-mesh material is wasted while the plus 60-mesh is carried by water in a trough to a Deister-Overstrom diagonal deck concentrator table. This table (Fig. 7) is also a very important step in the process as it separates the grit (sand and undecomposed feldspar) from the mica. Until this table was used, there was no good

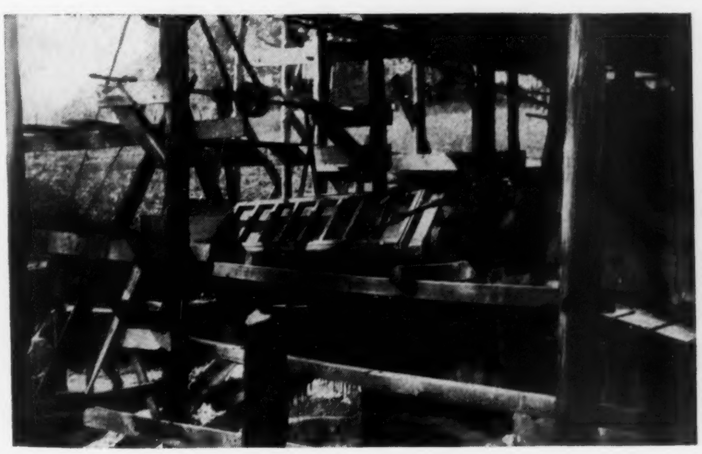


Fig. 6. Hexagonal screens set at 5 deg. from horizontal

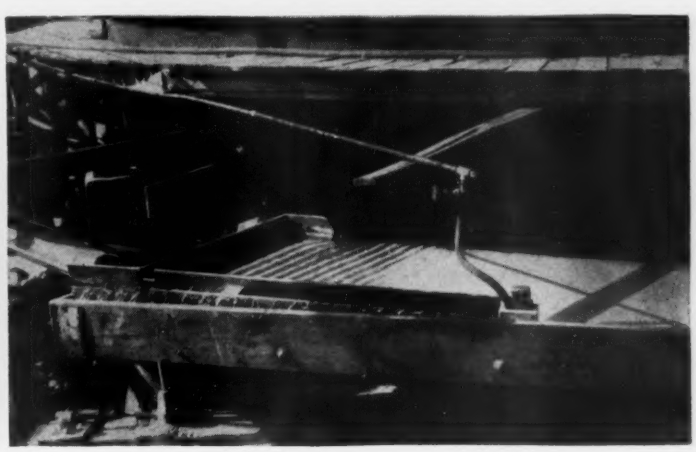


Fig. 7. Diagonal deck concentrator table

Fig. 8. Dewatering wheel and screen

method of separating the finest grit from the mica and the best results are obtained only when it is set at some definite angle. The angle is determined by the flow of water and the fineness of the material.

The grit from the Deister-Overstrom diagonal deck table goes to a waste heap while the mica goes by gravity water trough to a dewatering wheel. The screen of the dewatering wheel (Fig. 8) is 10-mesh finer than the finest mica which goes to it, that is the mica would be 60-mesh or coarser while the screen of the dewatering wheel would be 70-mesh. The mica finer than 60-mesh goes with the clay slip to the large Dorr-bowl classifier. If this process were applied to sand and gravel deposits instead of having the material go to the Dorr bowl classifier it could go direct to the batch of screens described later.

Final Screening

The product from the large Dorr bowl classifier is screened by two hexagonal revolving 80-mesh screens. The tailings are sent to the waste heap while the plus 80-mesh material goes to another Deister-Overstrom diagonal deck concentrator table. The product minus 80-mesh from the large Dorr bowl classifier goes to a battery of seven revolving 140-mesh screens. These screens are hexagonal in shape and are set 5 deg. from the horizontal just as the screens previously mentioned. From these screens, the product goes to the drier while the waste, principally clay, goes to the settling tanks (Fig. 9). The concentrate from the Deister-Overstrom diagonal deck concentrator table goes to the drier also.

This process gives three products by water classification, namely, 20- to 80-mesh 80- to 140-mesh and finer than 140-mesh. These three products are sent to separate storage bins and after being dried are rescreened to any mesh desired.

There are two driers, a direct heat drier which at the firing or hot end reaches a temperature of about 1500 deg. F., and a steam rotary drier which reaches a temperature of 400 deg. F. From the driers the product is conveyed by a monorail system to storage bins. From these storage bins the different products go to a double deck Rotex screen which has a capacity of 15 tons per day. The products usually desired by the trades are 20- to 60-mesh, 60- to 80-mesh, 80- to 140-mesh and minus 140-mesh.

The product from these plants is sold in direct competition with water-ground mica. Since these plants have been in operation five water-ground mica plants have closed down in the western part of this state. The small water-ground mica plants usually produce only 2 tons per 24-hour day, while the mica recovery plants produce from 3 to 5 tons. The product from the clay pits is in every way as good a product as that produced by the water-ground mica plants and can be used in the same trades. The chief use of this mica is in the roofing trade.

The *Engineering and Mining Journal* of March 9, 1929, quotes the prices as follows: "Mica-per ton f.o.b. plant: North Carolina: white, ground, 20-mesh, $35.00; 70-mesh, $100.00." The prices, however, received in the state according to information received from the producers brings from $20.00 to $120.00 per ton. The price depends on mesh, purity and to some extent brilliancy.

Possibilities of Mica Elimination from Sand and Gravel

By EDMUND SHAW

Contributing Editor, Rock Products

MICA IN SAND BARS, if for use in concrete, even though it is present in only small percentages, is very objectionable according to some specifications. It is one of the deleterious materials listed in the American Society for Testing Materials and the American Concrete Institute specifications. Those sand producers who are bothered with it will be glad to learn that there is a method not only of getting rid of mica but of turning it into a product that sells for $20 a ton and upward. This process is described in this issue of ROCK PRODUCTS, and while it has been worked out in the china clay industry there is nothing in the process that could not be applied in sand and gravel plants.

In the clay plants described the pebbles and larger pieces in the feed are wasted. In a sand and gravel plant this material would be the ordinary product of the plant after washing and screening. The part of the bank material that contains the mica is everything minus 10-mesh, but this might be a finer or a coarser mesh in various plants. The method, where a saleable product is to be made of the mica, is in five steps; first, classification to take out the clay and get a mixed sand and mica product; second, screening to 60-mesh to take out the stuff too fine to be economically treated; and

Fig. 9. Settling tanks for recovery of clay

third, running the screen oversize over a concentrating table to separate the mica from the sand. The fourth and fifth steps are the drying of the mica and screening to the sizes the market demands.

Considering how this process could be applied to sand and gravel plants, it would probably be necessary to screen all the sand of the plant to 10-mesh or thereabout, as a preliminary. This could be easily and cheaply done by one of the various mechanical or electrical vibrating screens now on the market. The undersize would then go to a mechanical classifier, either the Dorr simplex mentioned in the article or one of the sand drags which all manufacturers of sand and gravel machinery make. The overflow from this should be all finer than 40-mesh to avoid loss. Next would come screening to 60-mesh, which looks hard but which is said to be comparatively easy in the clay plants described. Hexagonal screens are used and it is said that they give no trouble from clogging. With other materials such trouble might develop, and if it did other screens might do better work, and as a last resort rising current classification could be tried, although this would cause some loss of mica. The coarser product would then be sent to concentrating tables, which for use in sand plants should be of the types designed to treat a heavy tonnage. Both products of the table are to be saved, the sand to be sold as mason's sand, or added to the concrete sand, if this is otherwise deficient in fines; and the mica could be dried and screened as described in the article. The table could be run to produce clean mica rather than clean sand without harming the sand, for the little mica that would stay with the sand would be below the percentage prohibited by specifications.

The costs of such treatment would be a small item compared with what would be received for the mica, if a market existed or could be worked up. The hardest problem is presented by those plants the sand from which contains enough mica to injure its saleability and not enough to justify the expense of a recovery plant with concentrating tables, dryers and fine screens. The best solution of such a problem that suggests itself is to take out the mica with some fine sand and then throw it away. This could be done by first screening all the sand to 10-mesh as before and then sending the undersize to a hindered settling classifier. Mica will float off from such a classifier with sand grains of a much smaller mesh size. If the mica and fine sand were to be saved the accumulation might in time justify the installation of a small mica recovery plant, including tables and dryers.

It should go without saying that before a plant for this or a similar process is built there should be enough small scale experimenting done to show that the materials can be satisfactorily treated, and that there is enough removable mica present to justify the investment.

"This Material-Concrete"

THE CONCRETE made in the United States sells for $2,000,000,000 annually, and $1,000,000,000 of this is the stake that engineers, material producers and contractors strive for, according to articles by Nathan C. Johnson, a well-known New York consulting engineer, published in recent issues of the *Engineering News-Record*. Fight would seem to be a better word than strive, according to the showing Mr. Johnson makes of the endless strife between contractors and engineers, brought on by what he says are obsolete practices and lack of standardization. Mr. Johnson admits that our concrete structures are strong enough; the restrictions of our building codes and the high factor of safety used to take care of that. But, he says, our standard specifications are intolerant and our practice is too narrow. Contractors and engineers know that provisions current as standard are violated daily in fact and in principle. The process of arguing out specifications, technically known as "crying," often reduces the engineer to a mere figurehead, if the contractor knows how to use sufficient pugnacity, skill and finesse, according to Mr. Johnson's argument.

By changing specifications so that they can be lived up to and all be treated alike, the concrete art may be standardized and we shall "avoid the wild swings in bidding that today cause millions of dollars of ultimate annual loss," a matter in which producers as well as contractors and engineers are deeply interested.

Our practices are founded on laboratory work which, Mr. Johnson admits, has been of the greatest value. But, he points out, the application of laboratory work to construction has led to "testing one thing and furnishing another." The test cylinder is carefully made according to exact and standardized methods, while the concrete is put in the forms in the way the weather and the time and skill available will permit. Yet whatever the quality of the concrete in the forms, it is accepted or rejected by the strength of the test cylinder at 28 days. The work may go on, for the structure will bear the load, even though it is made of alternate layers of honeycomb and laitance, for even laitance will bear the loads permitted by the codes, says Mr. Johnson.

"Strength—Mere Dogma"

Strength, according to Mr. Johnson, is mere dogma. The conditions for predetermining strength have been carefully worked out in the laboratory, but they can never be duplicated on the job. He shows this by calculations which run into the trillions, giving the permutations that may occur in mixtures of cement, water and aggregate. Laboratory determinations have their main value in showing us what is good common sense and what isn't. The lessons learned from them, and from figuring the possibilities of applying laboratory results in the field, he says, are: First, not to seek to save cement below a safe minimum; second, to use no more than two parts of sand to one of cement (less if the sand is fine); and third, to use all the stone or gravel possible.

While laboratory and field can never meet on a common ground, Mr. Johnson believes they can agree on the equity of a specification, based on the above, which will read something like this:

1. Use only one part of cement (as a basic requirement).
2. Use not over two parts of sand if the sand is coarse and less if the sand is fine (so that a common sense ratio shall not be exceeded).
3. Use as much stone as the mix will comfortably carry; and
4. Use only enough water to give mushy or workable consistency and without separation. (This will take care of the varying water content of the aggregates, yet permit the necessary lubrication of the mix.)
5. Place the concrete, after thorough mixing, evenly in the forms and puddle into place throughout any given section; and
6. Fill each section to the top in a continuous pour (so as to bring the concrete into some resemblance with the test specimen).

This specification, applicable to mass and reinforced concrete, upsets nothing and opposes nothing, according to its author, who acknowledges the cooperation of many earnest field men, engineers and architects in working it out. He says that under its provisions the contractor can use available local materials (with the sanction of the engineer) and get as good a result as the materials will permit. And he cannot be crucified under such a specification because it is definite.

In the concluding article of the series its author investigates the setting and hardening of concrete, its after life and some difficulties in protecting it and keeping its appearance. He believes that in the period just after wetting, when all the materials that are to set and harden are in solution, there is a possibility of manipulation by other means than manual which should not be overlooked. And one goal to be striven for is reliable tensile strength in concrete, and this he believes possible to attain.

Lime for Soap Making

THE Department of Commerce, Bureau of Standards, has released circular No. 372 in which appears the bureau's recommendations covering specifications of quicklime and hydrated lime for use in soap making. The six-page pamphlet outlines the use of lime in that industry together with the requirements and analytical methods for the determination of available lime, magnesia, insoluble and nonvolatile matter.

A Simple Titration Method for Determining the Absorption of Fine Aggregate

By J. C. Pierson
Assistant to Chemical Engineer, Lehigh Portland Cement Co., Allentown, Penn.

WITH increasing refinement in the methods of testing concrete, a need has developed for a more accurate and less cumbersome method of measuring the absorption of fine aggregate than the one commonly referred to[1] (not so commonly used). This need arises from the fact that there is a strong trend in present-day practice to place mortar and concrete testing on a water-cement ratio basis, instead of the cement-aggregate ratio basis, which has almost universally prevailed heretofore.

The reason for this change is that it is now generally recognized that when the water-ratio-strength relation is established from preliminary data on given combinations of cement and aggregates, it is probably the most useful single index that we have of the strength of any desired combination of these materials. One important consideration, however, has delayed this advance in the art, viz., the fact that we do not know, even in the laboratory, the *net* water ratio in any given mixture with the precision that we ought. If water leaks out of the molds, or rises to the top of the concrete after placing in the molds, or is lost by evaporation, or is absorbed by the aggregates, it must be taken into account in computing the net, or effective, water-cement ratio. It is a question whether, under present practices, the nominal water ratio, computed from the amount of water and the amount of cement actually used in the mix, does not probably differ from the true water ratio in the average laboratory test by more than ½ gal. of water per sack to cement. Take the case of a fine aggregate alone, which has, let us say, an absorption of 1%, and occurs in twice the volume (or weight) of the cement. The loss of water from the mix is then 2% by weight of the cement, or 3% by volume. In other words, the water ratio is lowered by nearly ¼ gal. per sack due to the absorption of the fine aggregate alone. An error of this magnitude should certainly be eliminated or reduced if possible, and the test described in the following paragraphs is a means to this end.

The Test in Its Simplest Form

A weighed quantity of dry sand, 200 g. to 500 g., is put in a quart mason jar of the type which has a flat cover with liner or gasket bearing on the rim of the jar (not the type sealed with a rubber ring, on an external shoulder, as this will allow material to be caught and held under the cover). From a small burette, which can be easily read to 1/20 c.c., a few drops of water are added, the cover is placed on the jar and the sand is shaken until the water is completely absorbed or distributed. The jar is then rolled in an inclined position, and if there is no sticking of the sand to the sides of the jar the water will have been completely absorbed. The cover is then removed from the jar, a few more drops of water are added, the cover replaced and the shaking repeated. As long as the absorption of the sand is not satisfied in this manner, the sand will appear dry and will not stick to the wall of the jar. Repeating this process until the sand grains show a tendency to adhere, we know that the end point is approaching. When after continued shaking and rolling the sand grains just persist in showing this tendency to stick to the jar, the test is completed, and the absorption is computed from the quantity of water added.

The end point of this test is quite sharp when the sand is clean and hard grained. Dirt, dust and silt interfere seriously with the detection of the end point, hence the sample should be washed prior to test. It is convenient to use for this test the dry clean residue of a sample which has been subjected to the decantation test for silt.

Origin and Principle of the Method

The method was suggested by Pettijohn's work on adsorption.[2] He used the titration method, essentially as described above, to determine the thickness of water films on non-absorbent grains. It is obvious that the method will serve to measure the absorption of porous grains, if we assume that the absorption is complete when persistent films of water form on the surfaces, and thus produce sticking of the grains to each other or to the walls of the container. This assumption seems justified, because it is difficult to see how a water film can persist on the surface of a grain unless the open pores and interstices within the grain are first filled by capillarity.

The main question in making the foregoing assumption was that of the necessary completeness of distribution of each added drop of water in the titration test. This question was answered in the following way: The test was made by using a stoppered flask instead of a mason jar as above described, and at the end of the test the flask with the sand and added water were weighed to the nearest hundredth of a gram. The sand was then over-wetted with a few c.c. of water and allowed to soak in the stoppered flask. Then a stream of air was aspirated through the flask by means of inlet and outlet tubes through a two-holed rubber stopper, the flask being continually rolled back and forth in an inclined position. In this manner the sand gave up its surface moisture gradually and uniformly, and the operation was continued until the surface films were just disappearing, as indicated by the last tendency of the grains to stick to the wall of the flask. The flask was then weighed, and the weight was found to be in very close agreement with the original weight. Thus fairly convincing evidence was obtained that when a dry sand is wetted the capillary openings which are connected with the surfaces of the grains become filled with water before surface films persist and the sand appears wet.

Accuracy of the Test

There are certain conditions and certain points in technique that affect the accuracy of the test; that is, the determination of a sharp end point. As previously stated, the sand must be fairly clean for a close determination. With no other precautions except ordinary care and a little experience, the simple jar test first described will give a determination of absorption correct within 1 or 2/10ths of 1%, frequently much closer than this, especially with a sand free from mica and a large quantity of grains below the No. 100 sieve. In general, however, the test made in this manner and completed, say, in about 10 minutes, is likely to give a result a little too low, because both absorption and distribution of the small increments of added water require an appreciable length of time for completion. The accuracy may be increased by using a flask for the determination, in which the sand and added water can be weighed as described in the preceding paragraph. After the titration is completed and the flask and contents are weighed, enough water (usually 1 or 2 c.c.) is added to distinctly wet the sand; then by means of the aspirator the sand is dried back to the end point and the flask and contents again weighed. This weight will generally

[1](The method is involved in the determination of "Apparent Specific Gravity of Non-homogeneous Fine Aggregates," A. S. Rea, *Proc. A. T. S. M.*, Vol. 17, Part II, p. 257, 1917.)

[2](Studies in Adsorption, Earl Pettijhon. Thesis submitted to Faculty of Graduate School, University of Minnesota, June, 1918.)

be slightly higher than the first, but the mean of the two will in most cases give the absorption within about 0.05% of the true value, assuming that one has had a little experience to familiarize himself with the process.

This mean value is taken as the most probable value because there is a tendency for the operator to stop a little short of the end point, whether he is approaching this from the dry side or the wet side. This tendency is not merely due to the operator's hesitancy to go too far with the titration or drying, but the temperature variations arising from manipulation have certain effects that tend to make the final weight higher than the weight obtained immediately after titration. During the latter operation when one is shaking and rolling the flask, moisture tends to condense on the interior of the flask and thus to produce sticking of sand while the absorption is still incomplete. This is particularly noticeable if the stoppered flask is allowed to stand a few minutes just before completion of the titration, or if a cool draft of air from an open door or window strikes the flask when near the end point. In such cases the sand will adhere readily to the glass, and some little shaking and rolling will be necessary to get the sand again to take up the condensed moisture. On the other hand if the wall of the flask is over warmed by the hands, the sand will tend not to stick, even when persistent films of water are formed on the surfaces of the grains, and there will consequently be a tendency to overdo the addition of water. This will not normally occur during the titration if ordinary care is taken in handling the flask, but it does occur in the drying back operation from the over-wet condition. In this case the evaporation of moisture from the sand into the aspirated air cools the sand, and since the walls of the flask are slightly warmer, the sand ceases to stick before the surface films on the grains are completely removed. This second end point may be appreciably too high unless the aspirator is disconnected and the sand in the flask shaken and rolled until it is certain that the surface water is removed.

Finally if a determination of maximum accuracy is desired, the proper method is to continue the operation described above for a short time, making repeated determinations of the end point, first by slightly over-drying and then titrating and then by over-titrating and drying back. The following example will serve to illustrate the method:

The exact source of this sand is unknown, but it is similar in type to the famous "Cow Bay" sand, and has an unusually low absorption.

In the writer's experience with this test, excellent results are obtained in most cases by using a 200 g. sample of sand and a 500 c.c. Erlenmeyer flask, in which the weighing, titrating and aspirating can be conveniently carried out. The simple titration test requires 10 or 15 min. on the average; for the drying back operation, from 15 min. to a half hour will be required, depending mainly on how much water is added to over wet the sand.

Values of absorption obtained by this method on a number of sands from different localities are given in the accompanying table.

Source	Absorption (per cent by weight)
Cressona, Penn.	1.05
Williamsport, Penn.	0.65
Harrisburg, Penn.	0.90
Morrisville, Penn. (Van Sciver)	0.80
Towson, Md.	0.35
Hyattsville, Md.	0.65
Buffalo, N. Y.	0.95
Springfield, Vt.	1.05
Washington, D. C. (Potomac R.)	0.65
Elgin, Ill.	0.80
Minneapolis, Minn.	0.65
Attica, Ind.	1.00
Ottawa, Ill.	0.03

Sand: From Long Island, used in construction of Lehigh Valley railroad warehouse, New York City (200 g. sample used).

	Grams	Grams
Weight of dry sand and flask	332.17	
Weight after first titration		332.73
Weight after adding 1 c.c. water and drying back		332.70
Weight after over drying 4 min. and re-titrating		332.68
Weight after adding 0.15 c.c. water and drying back		332.69
Weight after over drying 2 min. and re-titrating		332.70
Check weight after complete drying	332.14	
Average	332.16	332.70
Weight of absorbed water	0.54 g.	
Per cent absorption (by weight)	0.27%	

A Study of Flotation

THE FLOTATION PROCESS is only of academic interest to the rock products industry at present, but as it is being experimented with in cleaning bauxite, and some other minerals, including limestone and phosphate rock, a knowledge of its theory is becoming important. It also provides a market for considerable lime, and this market may be increased according to the results of tests given in Technical Publication No. 195 of the American Institute of Mining and Metallurgical Engineers, in which lime is shown to function well as a dispersion agent in the floatation of sulphide minerals.

A part of the pamphlet which should interest lime producers for another reason is that which describes the Burton tube and its use. This might well be used to determine the colloidal properties of limes, according to the method of Ray and Mathers, described in the May 26, 1928, issue of ROCK PRODUCTS. This method measures the migration of colloidal particles (cataphoresis) when influenced by an electrical charge. In the Burton tube the material, lime for example, in suspension is placed in a thistle tube connected to the bottom of a U-tube, and by careful manipulation it may be made to rise in the arms of the U-tube, leaving a clear water space above. The electrodes are in the clear water so bubbles thrown off the electrodes do not affect the settlement of the suspended particles. By comparing the settlement in the two arms after the current is turned on, an idea of the colloidal content of the lime is obtained and it would appear from the experiments of Ray and Mathers that the effect may be read quantitatively for colloidal behavior.

New Soundness Test for Lime

IN THE COURSE of an investigation of factors causing unsoundness in lime plasters a new method for experimentally determining unsoundness has been developed by the Bureau of Standards. The lime which is to be tested, either quicklime or hydrated lime, is made into a putty by the addition of water. One part of gaging plaster is added to two parts of the lime putty, and after thorough mixing, the paste is spread in a thin layer on an absorbent porcelain plate. The plate is then allowed to remain undisturbed for about one hour, or until the paste has set. It is then placed in autoclave and steamed for two hours at a steam pressure of from 20 to 25 lbs./in.^{2} The plate is then removed from the autoclave and examined. Unsoundness is evidenced by popping, pitting, or cracking of the plaster.

The procedure as a whole follows the general method for the use of the lime in plaster. The mixture of lime and gaging plaster is the same as would be used in the finish coat on a wall. The porcelain plate takes the place of the base coats of plaster. The steaming under pressure apparently produces in a few hours conditions which are obtained only after months of exposure.

The results obtained by this test are being checked by preparing panels of the same materials which are allowed to age in the laboratory, and are being examined periodically. The present standard method for determining unsoundness is that proposed by the American Society for Testing Materials (A. S. T. M. Standards, 1927, Pt. II, p. 48). Thus far five limes which appeared to be sound by the A. S. T. M. method have been found unsound by the new method. All five limes have developed unsoundness in the panels prepared from them.

The new test has an advantage over the present standard test in that it may be completed in four hours or less, whereas the standard test requires three days for completion.—*Technical News Bulletin* of the U. S. Bureau of Standards.

The Manufacture of Plaster of Paris

A Review of the U. S. Patents Relating to the Processes and Apparatus for the Production of Plaster of Paris

By Joseph Rossman
Washington, D. C.

THE PRODUCTION OF PLASTER of Paris from gypsum has been known for hundreds of years. About 2000 years ago a Greek treatise on minerals stated that:

> Gypsum is prepared for use by burning certain stones. It is then reduced to powder, and well mixed with water by stirring with wooden instruments. The mixing cannot be done by hand because of the heat which is developed. This mixture is prepared immediately before it is used, for in a very short time after moistening it dries and becomes hard and not in a condition to be used. The gypsum which has been used can be reburnt and made fit for use.

The preparation of plaster of Paris today is performed in exactly the same way, except that more efficient methods and means have been developed.

The mineral gypsum is a hydrated calcium sulphate $CaSO_4 \cdot 2H_2O$ which when heated to 107 deg. C. is converted to the hemihydrate $(CaSO_4)_2\ 2H_2O$ which forms plaster of Paris. When this is moistened with about one-third of its weight of water a plastic mass is formed which sets in from 5 to 15 minutes to a white hard mass by combining with the water of crystallization. When plaster of Paris is heated above 200 deg. C. an anhydrous calcium sulphate is formed which does not set with water. It is called dead-burnt plaster. In actual practice gypsum must be heated to a temperature sufficiently high to remove ¾ of its water of crystallization and below the temperature necessary to dehydrate it completely. It is therefore very important to carefully regulate the temperature in heating gypsum to produce a good grade of plaster of Paris.

The Gypsum Kettle

Gypsum is found in central and western New York, Virginia, Ohio, Michigan and in the western states such as Kansas, Oklahoma, Nevada and California. The gypsum is mined, crushed and pulverized prior to its calcination in the gypsum kettle which holds from 7 to 12 tons of gypsum. It is set in brick work and heated by a furnace beneath it. A stirrer is usually provided to agitate the gypsum as it is being calcined. This process is called boiling, because as the steam escapes from the mass the gypsum has the appearance of a boiling liquid. The kettles are ordinarily arranged in pairs with a pit into which the calcined gypsum from one kettle may be emptied while the other kettle is being cooked.

Types of Kettle Stirrers

A number of different types of stirrers have been designed to agitate the gypsum while it is boiled. Usually a shaft extends through the center of the kettle and upon its lower end is provided with radial arms. In patent No. 519,259 the radial arms carry a number of independent blades which pass close to the curved or arched shaped bottom of the kettle and agitate the material. Patent No. 577,059 uses a flexible connection between the scrapers and the radial arms so that the scrapers may yield both vertically and laterally to accommodate themselves to variations in the bottom of the kettle. The paddles may also be secured by keys or wedges so that they can be adjusted as in patent No. 670,597. Patent No. 850,041 shows an S-shaped central paddle and L-shaped paddles at the end of the rotating arm so as to engage the walls of the kettle.

Types of Kettle Flues

In order to uniformly heat the entire mass of gypsum the kettle has been provided with flues extending through the body of the kettle through which the heated gases from the furnace may pass. A series of radial flues extending through the kettle are shown in patent No. 221,689. A series of superimposed flues extending within the kettle are shown in patent No. 577,059. Detachable vertical flues extending along the lower part of the kettle are provided in patent No. 618,902. In case any section of the bottom needs repairing, this can be done without removing all the flues or disturbing the setting. Semi-circular flues are used in patent No. 670,597. In order to prevent the contents of the kettle from piling up upon the tops of the flues a sweeping or knocking device is provided to remove the cohering particles in patent No. 761,684.

Calcination by Steam

In order to avoid the burning out of the kettle bottom and to provide for a uniform calcination of the gypsum, steam has been utilized in preparing plaster of Paris. Patent No. 343,181 uses superheated steam which is conducted to the specially constructed outer and inner jackets of the calcining kettle, thereby heating the gypsum. A series of steam-jacketed, inclined, rotating cylinders are used in patent No. 781,747 to calcine the gypsum.

Preheating of Gypsum

Several processes provide for the preheating of the gypsum before it is finally calcined so as to economize in the fuel used. An early patent No. 7439 uses three superimposed kettles which are heated by a single furnace. The charge from the upper kettle passes to the lower kettle and is finally calcined in the lowermost kettle. In patent No. 813,182 two superimposed kettles are shown heated by a single furnace. The heated gases pass under and through the kettles. The charge from the upper kettle passes into the lower kettle. Gypsum is also preheated in patents Nos. 852,616 and 1,446,863.

Rotary Kilns

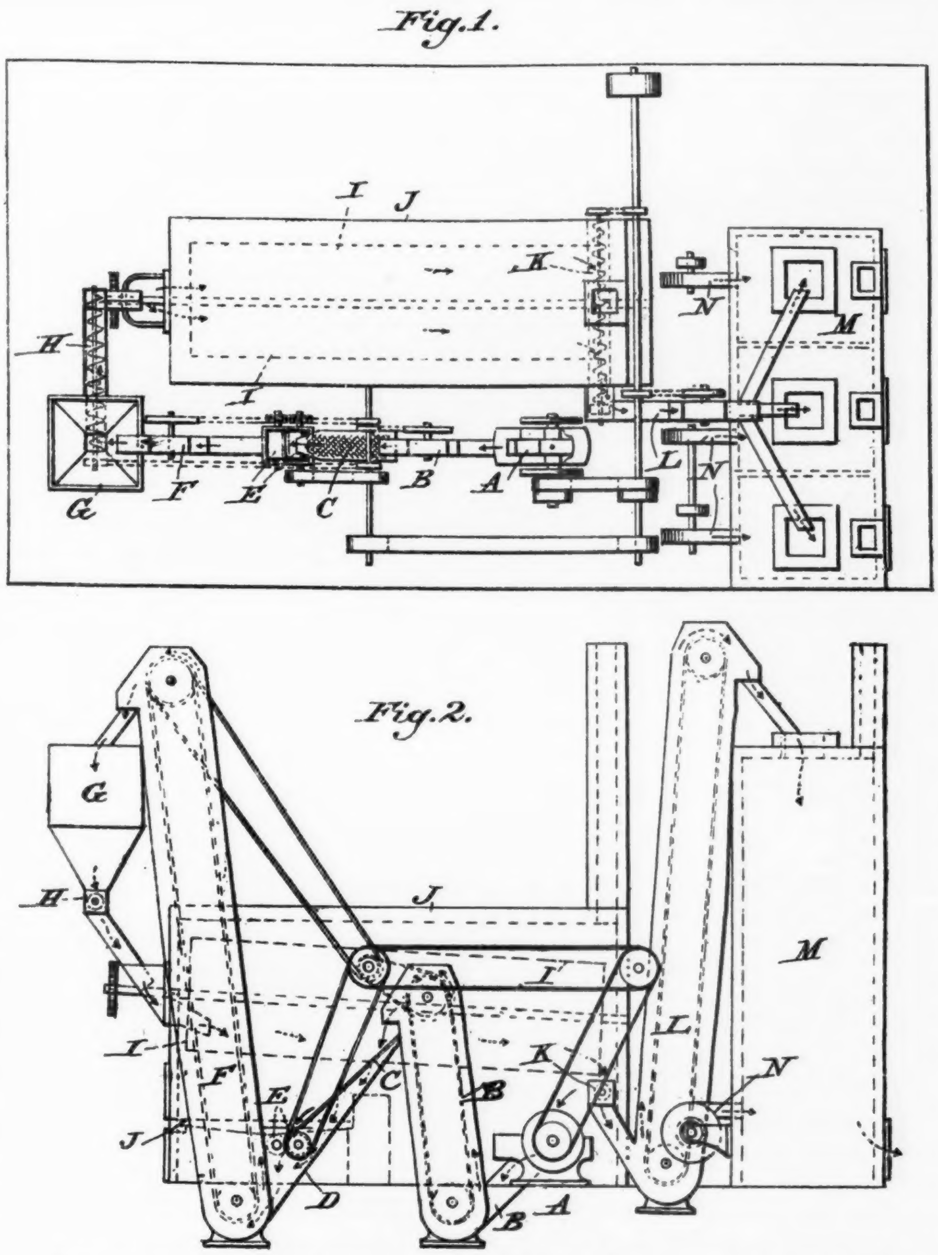
Rotary kilns have also been built for calcining gypsum. Patent No. 57,892 shows two rotary kilns which have an internal screw conveyor. The gypsum passes through one kiln and then through the second kiln, where it is completely calcined.

The Cummer Process

In the Cummer process, patent No. 674,760, (shown in the illustration on the following page) the raw material is fed into the crusher *A*, where it is broken into small particles. The material so broken is carried from the crusher by the conveyor *B* and deposited upon the upper end of the inclined screen *C*. The reticulations of the latter are such that all particles of about the size of a hickory-nut and smaller will pass through the same and fall into receptacle *D*. The larger particles that cannot pass through the screen are fed between the auxiliary crushing-rolls *E* and are reduced to the same size as those that has passed through the screen and are gathered in the receptacle *D*. The material thus comminuted is then carried by the conveyor *F* into the hopper *G*, from which it is fed by the screw conveyor into the hopper *G*, from which it is fed by the screw conveyor into the rotary drum *I*, located in the furnace *I*. While in the drum the comminuted material is partially dehydrated, and when it leaves the drum it has a temperature of about 300 deg. F. The material so treated is then carried by the conveyors *K* and *L* to one of the closures or bins *M*, where it is substantially excluded from the air to retain its heat and the dehydration is completed by the resident heat of the material.

The Birdsey Process

This process as given in patent No. 1,412,203 calcines fine and coarse particles in one operation and then separates them so as to form two products of different natures. The



Cummer process apparatus, patent No. 674,760. Fig. 1 is a plan view and Fig 2 is the elevation

operation of the device may be briefly described as follows: Heat is generated in the furnace 10 and drawn through the calciner by the fan 26 or by the ordinary draft due to a high chimney or the like, the drum rotates continuously and as material is dumped into the hopper 13, for example, material such as gypsum rock crushed as desired, the particles being of various sizes, small, medium or large, the same is uniformly and continuously fed from the hopper 13 through chute 12 into the drum 1.

Owing to the blades or shovels 9 and the inclination of the drum, if the drum is inclined, the material in the rotating drum is carried to the discharge end, all parts being subjected to the heat. As it is carried along, however, it is perfectly and uniformly calcined. The degree of calcination may obviously be controlled by the intensity of the fire in the furnace 10, or hot gases produced and admitted to the drum, and the time required for the material to pass through the drum which will be governed by the pitch of the drum or shovels and the speed at which it is driven. The passage of the gases through the drum may be controlled and varied by means of the fan as well as by the fire, the fan affording a quick and easy control. The temperatures may of course be determined by the thermometers 16 and 16'.

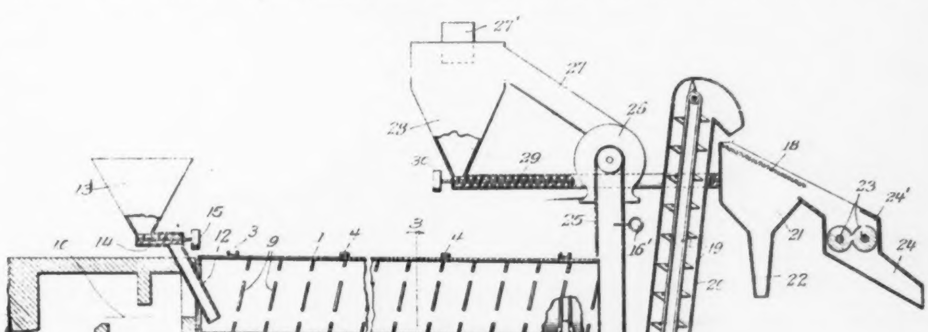
When the calcined material reaches the discharge end of the drum it falls into the chute 17 and into the well, whence it is elevated by means of the buckets 19 and discharged onto the screen or separator 18. The fine particles fall through the screen and are discharged through spout 22 and carried away in any desired manner. The particles too coarse to pass through the screen move off and pass through the crusher so that they are evenly and thoroughly pulverized, and a uniform product is the result.

Any of the lighter calcined particles that might be drawn up through the stack 25 will fall into the hopper 28 and be conducted to the hopper 21. By controlling the material placed in hopper 13, i.e., the percentages of fine and coarse, the time and heat, etc., the materials discharged may be varied, depending on the demands for the products. In other words, one or more products may be obtained from one calciner, the products varying in characteristics, being in the desired relative proportions as well as in characteristics.

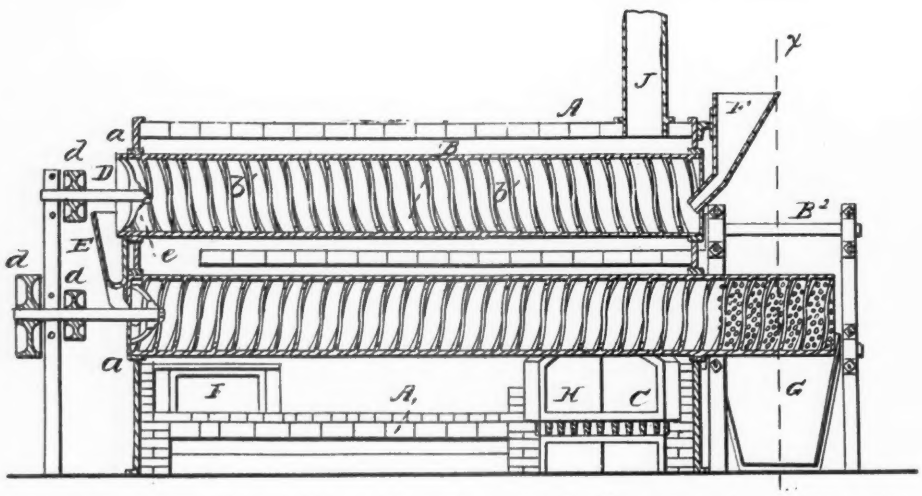
Plastic Gypsum

Calcined gypsum, or plaster of Paris, is of crystalline structure and sandy character. Because of this characteristic, calcined gypsum cannot be used alone for the white or finishing coat of plaster; the plasterer is not physically able to spread it. For the same reason not more than two or three parts (by weight) of sand may be added to it in the preparation of the scratch or brown coats of plaster. This characteristic is described in the trade as "non-plastic."

In patent No. 1,392,574, which is dedicated to the public, the gypsum is ground severely so as to liberate the water without allowing it to escape giving a plastic gypsum. If calcined gypsum is ground after calcination, one of two things may occur: If the grinding is not severe, the crystals will be re-



Apparatus for the Birdsey calcining process, patent No. 1,412,203



Godfrey patent No. 57,892. An early patent having two rotary kilns with spiral conveyors, the gypsum passing first through the upper kiln and then through the lower one

duced in size, but the sandy or non-plastic nature of the material will still remain. If the grinding is very severe, a chemical change can be made to occur, the water being actually ground out of the material.

In actual practice, a buhr mill or tube mill is used for this grinding, and any water which is liberated is evaporated and carried off by the current of air passing through the mill. The resultant product is known as "soluble anhydrite." This is anhydrous calcium sulfate, but it differs from the naturally occurring anhydrite in that it has a great affinity for water. So great is this affinity that a few moments exposure to moist air is sufficient for it to recombine with enough water to change back to the original calcined gypsum. Because of this fact, and also because the soluble anhydrite is itself crystalline, the effect of this severe grinding is lost, and the product is still non-plastic.

Commercial gypsum plasters consist mostly of calcined gypsum, with more or less soluble anhydrite and undecomposed gypsum. If calcined gypsum is ground severely so as to liberate the water, but in such a way that the water cannot escape, the resultant product has radically different properties. It is now plastic rather than non-plastic. Plastic gypsum can be used as the white coat of plaster without further treatment. It is superior to the ordinary non-plastic gypsum or calcined plaster in making hardwall plaster, gypsum blocks or other plaster products. In patent No. 1,457,161 plastic gypsum is made by passing calcined gypsum through a tube mill without permitting the loss of the water content during the grinding.

Artificial Ageing of Calcined Gypsum

On storing calcined gypsum its water consistency drops as compared with freshly calcined gypsum, thus giving a denser casting. Storage is an expensive and inconvenient procedure. In patent No. 1,370,581 the given raw material is introduced into the calciner and not more than 1% by weight of calcium or magnesium chloride dissolved to a saturated solution is added. The mechanical agitation of the gypsum thoroughly incorporates the deliquescent chloride. An artificially aged product is thus obtained.

Another process for ageing gypsum is given in patent No. 1,659,971. After the gypsum has started "boiling" borax 1/10 of 1% by weight of raw gypsum is added in a concentrated solution. The kettle is heated to 340 deg. F., giving a plaster having 5% to 6% residual water. The second boiling operation is then commenced, the gypsum being heated to 380 deg. to 420 deg. F., during which period finely ground raw gypsum is added in the proportion of 25% to the weight of the charge being calcined. This product requires no storing or ageing and gives a hard, dense material.

Gypsum From Waste Products

An interesting recent patent No. 1,548,358 makes synthetic plaster from the calcium surfate residue produced as a byproduct in the manufacture of phosphoric acid. A slurry is made from this waste material. The acid content is neutralized by sodium carbonate. The free liquid containing the sodium salts is removed and the remaining product is calcined in the usual manner. The undesirable acids are thus removed by this process giving, it is claimed, a good plaster.

The following abstracts give a survey of the U. S. patents relating to the production of calcined gypsum:

1. *Benjamin Fowler. Patent No. 7439, June 18, 1850.*

The apparatus has three chambers, one above the other, in addition to the pan or boiler commonly used, so that each chamber may contain a charge, and all be heated at the same time by the fire in the furnace under the pan by means of tubes, or pipes, passing from the furnace upward through all the chambers. The bottoms, or floors, of the two upper chambers are formed of beams, or bars, brought to an edge at the top, and the intervening spaces are filled with slides, or movable valves, so that the charge may be readily let fall into the chamber next below.

The sides and bottom of the lower chamber are made in the form of inclined planes, descending toward the door, so that on opening the door the charge will readily run into the pan, or boiler, where it is to be finished in the common way. The gypsum is heated gradually in its passage through the several chambers, and is finished with ease and dispatch when it reaches the pan, as not more than one-fourth part of the time usually occupied will be required, and therefore much labor will be saved.

In having the chambers one above the other the charge of gypsum may be readily transferred by its own weight, from one chamber to the other, and from the lower chamber to the finishing pan. In the arrangement of the tubes the gypsum will be heated and brought forward in the chambers by the heat from the furnace which would otherwise be wasted, so that, after the first charge, four charges, at least, may be finished in the time occupied to finish one by any of the methods heretofore used.

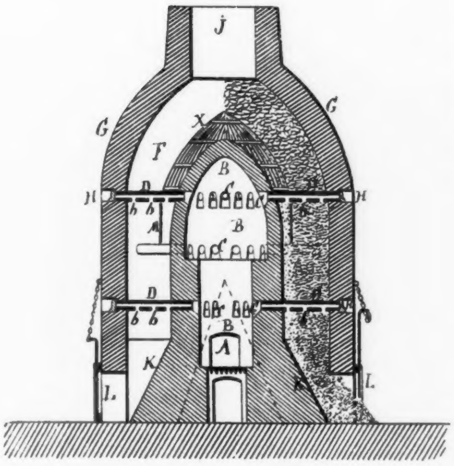
2. *Godfrey. Patent No. 57,892, September 11, 1866.*

Under the ordinary mode, gypsum is calcined in considerable quantities at a time in a large stationary boiler or heater, in which the gypsum is subjected to the action of the heat for a sufficient length of time to be converted into a calx, when it is permitted to run off in a body through a door or gate thrown open for that purpose. An arm or rake near the bottom of this boiler is turned around by a vertical shaft, to agitate the gypsum or plaster and prevent the same from being burnt by remaining against the sides or bottom of the boiler; but in consequence of the large amount of plaster within the boiler a perfect calcination cannot be effected, as the plaster is not acted upon equally by the heat.

This invention employs two rotary boilers, located within a fire-arch, and provided with spiral conveyors, whereby the plaster is caused to travel through one boiler and discharged through a spout into the other, and thence to a distributing device, which deposits the plaster on a cooling-surface in a condition to be packed in barrels. The spiral conductors carry the plaster along in small quantity as fast as it is supplied to the boilers, thus keeping it in a state of constant agitation, and the steam, with the sulphuric-acid gas which is generated during the process, rises to the upper part of the heaters and escapes at the open ends of the latter.

3. *Mabille. Patent No. 207,755, September 3, 1878.*

The kiln is composed of a fireplace or furnace, placed at the lower part of a central chamber, the roof or crown of which is vaulted ovally and constructed of refractory bricks. This arrangement has the effect of forcing the products of combustion reflected from the vault to descend toward the furnace. At the interior of this chamber above the furnace are arranged channels or outlets,



Mabille potent No. 207,755. Gypsum kiln with a grating at the top for removing dust from raw material, and with flue pipes extending through calcining chamfer

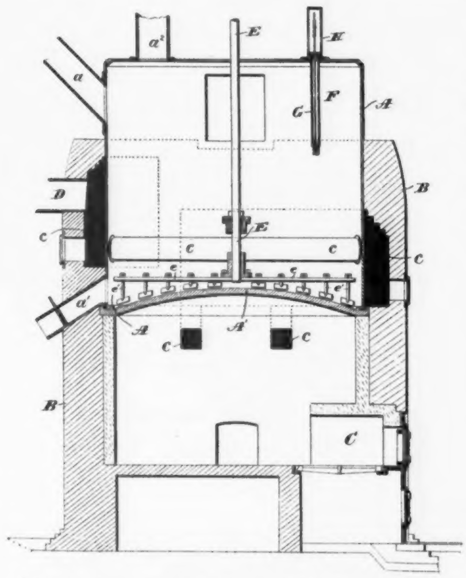
these being superposed in alternate order, and leading into pipes for conducting the heat into an annular chamber which surrounds the casing or wall of the inner chamber. The dome of the central chamber is covered with a grating of the same form. Thus the dust in the gypsum on arriving at the grating passes through it and enters the space existing between the grate and the dome, slides down the latter and follows the conduit formed by the partition.

4. *Merritt. Patent No. 221,689, November 18, 1879.*

The kiln consists of a steam-boiler provided with a series of horizontal tubes radiating from the combustion or fire chamber, so as to permit a free passage through the inner and outer shells, in combination with a gypsum boiling or calcining apparatus, of brick or other suitable material, arranged so as to form an annular space between it and the steam-boiler, to receive the gypsum to be calcined and provided with a series of tubes radiating from the boiler-tubes having a row of perforations or a narrow longitudinal opening through their lower sides, thereby providing a passage from the combustion-chamber in the boiler to the gypsum-chamber, so that the gypsum is calcined by the escape-heat from the steam-boiler.

5. *March. Patent No. 343,181, June 8, 1886.*

The process of calcining gypsum which



Higginson patent No. 519,259. Gypsum kettle having scraping blades for the bottom

consists in superheating steam and conveying it to a vessel or kettle filled with gypsum and provided with a steam-jacket on its bottom and sides and an interior steam-jacket from which the steam is radiated, and agitating the gypsum to expose its particles equally to the heating surfaces.

6. *Davidson. Patent No. 413,496, October 22, 1889.*

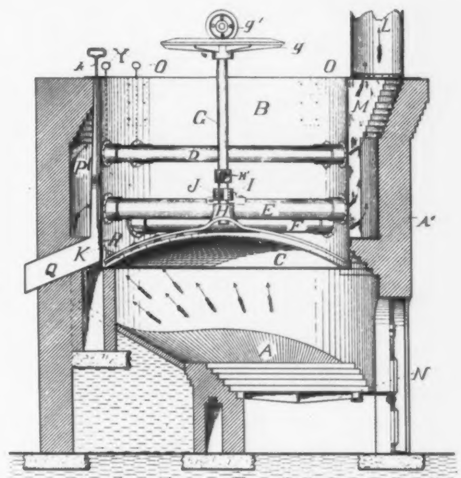
The invention converts the raw gypsum into calcined gypsum or stucco by a continuous drying process, the raw material being continually fed to the kettle and the calcined material taken from the bottom without necessitating a stoppage of the operation.

7. *Bourne. Patent No. 480,381, August 9, 1892.*

The calcining kettle is heated indirectly by heat deflected from a specially constructed furnace. The material in the kettle is stirred by a rotating arm.

8. *Higginson. Patent No. 519,259, May 1, 1894.*

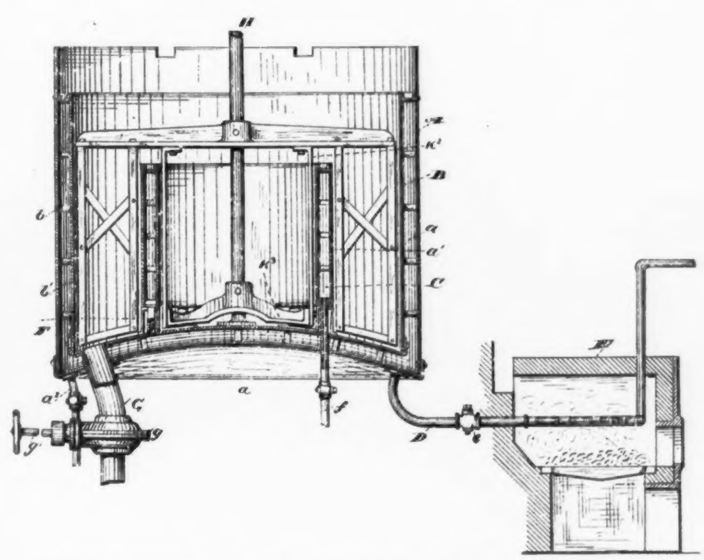
The method of calcining plaster which consists in heating it within a kettle to a temperature of about 395 deg. F., permitting it to cool to a temperature of about 365 deg., then giving it a temperature of about 380 deg., and finally discharging it at such temperature.



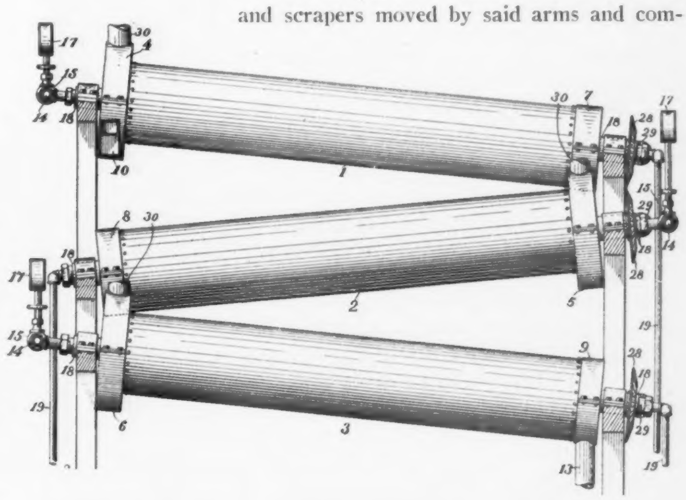
McNeal patent No. 577,059. Gypsum kettle having flues extending through the body

9. *McNeal. Patent No. 577,059, February 16, 1897.*

A calcining apparatus, comprising a furnace, a vessel suspended therein provided with an upwardly-convexed bottom and having an outlet for material, a bridge or bar extended across the outlet, a vertical shaft in the vessel, arms extended from said shaft, and scrapers moved by said arms and com-



March patent No. 343,181. Calcining kettle provided with a steam heating surface about bottom and sides, and having an agitator

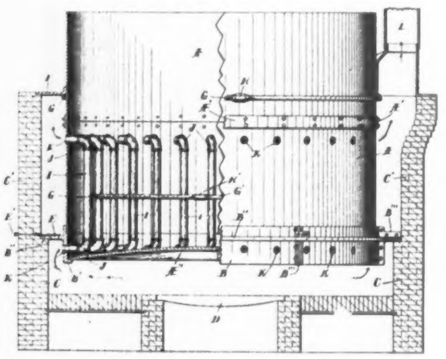


Simonds patent No. 781,747. Calcining apparatus consisting of three steam-jacketed, inclined rotating cylinders

prising substantially V-shaped end scrapers, the said end scrapers being guided across the outlet by said bar or bridge.

10. Powers. Patent No. 618,902, February 7, 1899.

A calcining-kettle consisting of a cylindrical shell, a detached bottom, a bottom ring in detachable segments and having an inwardly-projecting flange to support the



Powers patent No. 618,902. Gypsum kettle with series of vertical detachable flues near the shell

bottom, and an outwardly-projecting flange to support the kettle, and detachable flues having elbows and nipples and extending through said ring and shell at their respective ends and at each side of the outwardly-projecting flange and an expansion-ring to hold said flues in place.

11. Calvert. Patent No. 622,327, April 4, 1899.

A calcining-furnace, comprising a cupola kettle arranged within the cupola, a vertical flue and an annular chamber arranged between said cupola and kettle, horizontal flues extending through the kettle and communicating with the chamber and flue, a combustion-chamber located beneath said kettle, parallel walls extending on each side of the combustion-chamber and formed with ducts for the admission of atmospheric air to said combustion-chamber and with inlet-orifices communicating with the atmosphere.

12. Hook. Patent No. 624,709, May 9, 1899.

The method or process of manufacturing plaster product and the like, consisting in first submitted suitable material to the operation of calcining until reduced to a finely-subdivided or pulverulent condition, then immediately subjecting said material, while in its intensely-heated and pulverulent condition, to the influence of a current of cold air in rapid motion and of such strength that the particles are taken up and carried in suspension separately and individually, and rapidly cooled.

13. Powers. Patent No. 670,597, March 26, 1901.

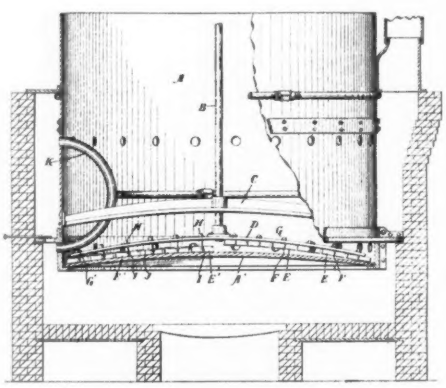
The combination of a kettle having a convex bottom, a sweep rotative above the bottom, a paddle rigidly secured to the end of the sweep and traversing close to the rim of the bottom, a series of vertically-movable paddles traversing the bottom and in contact therewith and means for connecting the vertically-movable paddles with the first-named paddle, whereby the entire series of paddles are held parallel.

14. Cummer. Patent No. 674,760, May 21, 1901.

In carrying out the invention gypsum or hydrous calcium sulphate is comminuted to such a degree that its largest particles will be about the size of, say, hickory-nuts. The material so divided is then subjected to the action of extraneous heat produced by a suitable generator until it reaches the temperature of about 300 deg. F., during which period the dehydration has commenced and has been partially completed. The material is then removed from the action of the extraneous heat and is placed in an inclosure, where the dehydration is finished by the resident heat of the material. After the completion of the process of dehydration the resultant product may be subjected to the action of air under pressure to be cooled.

15. Malone. Patent No. 756,669, April 5, 1904.

An apparatus for cooking gypsum for converting the same into cement-plaster, comprising the furnace having a fire-box,



Powers patent No. 670,597. Gypsum kettle provided with scrapers and curved flues

the kettle proper having a lower half projecting within the fire-box and an upper half of greater diameter than the lower half, and resting upon the walls of the furnace, the hollow shaft extending through the kettle proper and receiving the products of combustion at one end, the stack to which said hollow shaft discharges at its other end, the yielding scrapers supported on the hollow shaft, the discharge-spout, and means for controlling the same.

16. Brothers. Patent No. 757,649, April 19, 1904.

The invention consists, essentially, in treating calcium sulphate either in the natural form of gypsum or in the powdered form of a chemical byproduct or other form in water or in an aqueous solution—such as a solution of potassium sulphate, borax, or alum—at a temperature between 212 deg. and 260 deg. F. or 100 deg. and 130 deg. C. and then separating out and drying the solid product without allowing it to cool below 175 deg. F. or 80 deg. C.

17. Koneman. Patent No. 776,186. November 29, 1904.

In apparatus for calcining gypsum, or the like, the combination of a furnace, a calcining chamber, a plurality of heat-radiating flues communicating at one end with the said furnace, to conduct the hot products of combustion therefrom, and crossing said chamber, a series of vapor-abstracting conduits crossing and open to said chamber, and means for feeding the material to be calcined against and past the sides of said flues and conduits, the said flues being all closed to said calcining-chamber whereby the said material is kept from physical contact with the hot products of combustion from the furnace during the entire calcining operation.

18. Simonds. Patent No. 781,747, February 7, 1905.

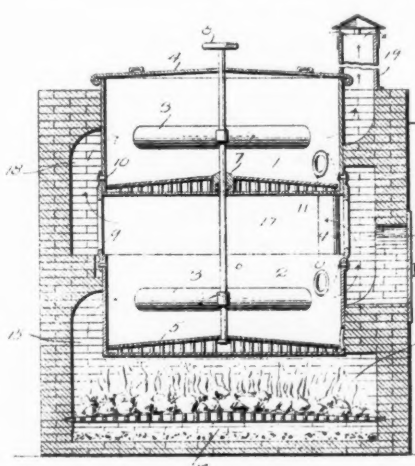
The method of calcining plaster consisting of passing a continuous stream of plaster through a series of steam-jacketed and inclined rotating cylinders, supplying steam to said cylinders to heat the same, regulating the pressure of the steam to determine the temperature thereof, and adjusting the temperature of the plaster.

19. Womack. Patent No. 813,192, February 20, 1906.

A furnace having a plurality of kettles, disposed one above another and spaced apart, means to cause the heated products of combustion to continue to pass under and through the heated kettles, and means to discharge the material from the upper kettle into the lower kettle.

20. McNeal. Patent No. 850,041, April 9, 1907.

The combination with a furnace, of a cal-



Womack patent No. 813,192. Two superimposed kettles heated by a single furnace, the gypsum being preheated in the upper kettle and calcined in the lower

cining vessel arranged therein and having a convex bottom, a shaft extended vertically in said vessel, a bar attached to the lower end of said shaft, a plurality of scrapers having link connection with the bar, and a central scraper consisting of two sections curved in opposite directions and pivotally connected

together, said central scraper being carried by said bar.

21. *Raithel. Patent No. 852,616, May 7, 1907.*

A gypsum burning-kiln, characterized by the kiln being constituted by two heaters, of which the main heater arranged directly over the combustion chamber is deeper than the other or auxiliary heater and passes through the latter in such manner that the auxiliary heater with which the escaping combustion gases come into contact, forms an annular chamber around the main heater.

22. *Kibler. Patent No. 761,684, June 7, 1904.*

In a calcining apparatus, the combination with a kettle or shell having flues extending into the same, of an agitator in said kettle, and means actuated by said agitator for removing the portions of the contents of the kettle which adhere to said flues.

23. *De Jonge and Nevers. Patent No. 907,-575, December 22, 1908.*

The device consists essentially of two large, concentric, upright tubes connected by annular heads at the ends, the inner tube being divided transversely by a diaphragm into a fire-box below and a receptacle for the material to be calcined above, and flues extending from the fire-box upward between the tubes and through the upper head, the device being provided with an agitator, breeching, smoke pipe, cover air pipe and blower.

24. *Bishop. Patent No. 986,350, March 7, 1911.*

An apparatus comprising a furnace having a main heating flue, a calcining chamber having its under side forming the upper side of the main heating flue, a rotatable cylinder located within the calcining chamber and providing an auxiliary heating flue connected with and extending forwardly from the rearward end of the main heating flue, an exhaust flue with which the forward end of the rotatable cylinder is connected, a screw conveyor and mixer secured to the rotatable cylinder, narrow at its forward part and spaced from the rotatable cylinder and widened at its rearward part to the surface of the rotatable cylinder, means for feeding the material to the calcining chamber and means for driving the rotatable cylinder.

25. *Brookby. Patent No. 1,370,581, March 8, 1921.*

The process of treating gypsum products consisting in adding to the gypsum during the calcining process substantially one-tenth of 1% by weight of a deliquescent chloride of alkaline earth metal. This gives a calcined product which is aged in a manner approximating the same condition as warehousing or storing for a considerable period of time after its calcination.

26. *Emley. Patent No. 1,392,574, October 4, 1921.*

Calcined gypsum is ground severely so as to liberate the water, but in such a way that the water cannot escape, the resultant product has radically different properties. It is now plastic, rather than nonplastic. If it is not practicable to grind the calcined gypsum in such a way as to prevent evaporation of the liberated water, the same end can be attained by adding, either before or during the grinding, enough water to make up for the quantity evaporated, so that the final product will contain approximately one molecule of water to two molecules of calcium sulphate. This patent is filed under the act of March 3, 1883, and can be used without the payment of royalties.

27. *Birdsey. Patent No. 1,412,203, April 11, 1922.*

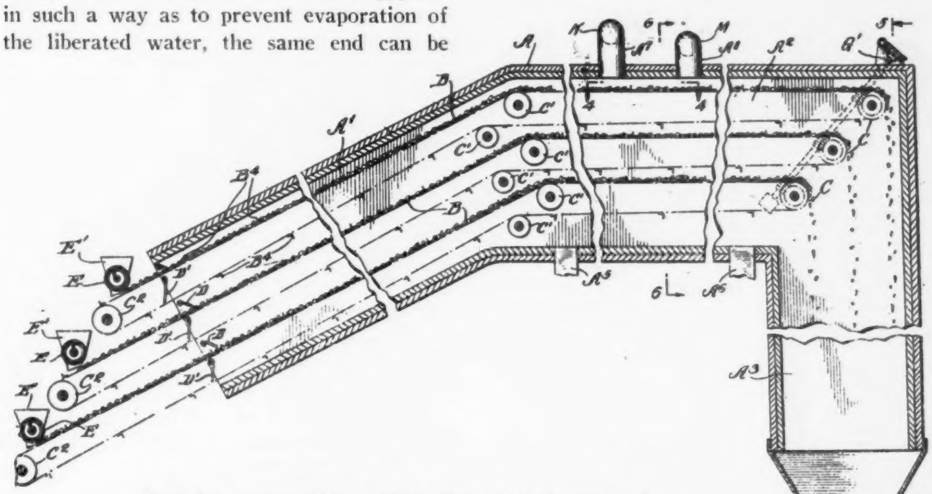
A method of treating gypsum rock, consisting in passing various sizes of gypsum rock particles through a calciner, and agitating the same and applying heat thereto during the agitation, then separating the coarser particles from the finer particles and grinding the former, whereby two products of different natures are secured.

28. *Hennicke. Patent No. 1,442,406, January 16, 1923.*

In the process of making a hydraulic substance from anhydrite, the steps which consist in treating raw anhydrite with water and a soluble catalyzer such as alkali salts, sulphuric and hydrochloric acid, heating, extracting the catalyzer, heating the residue under reduced pressure metween 80 deg. C. and 170 deg., and grinding.

29. *Townley. Patent No. 1,446,863, February 27, 1923.*

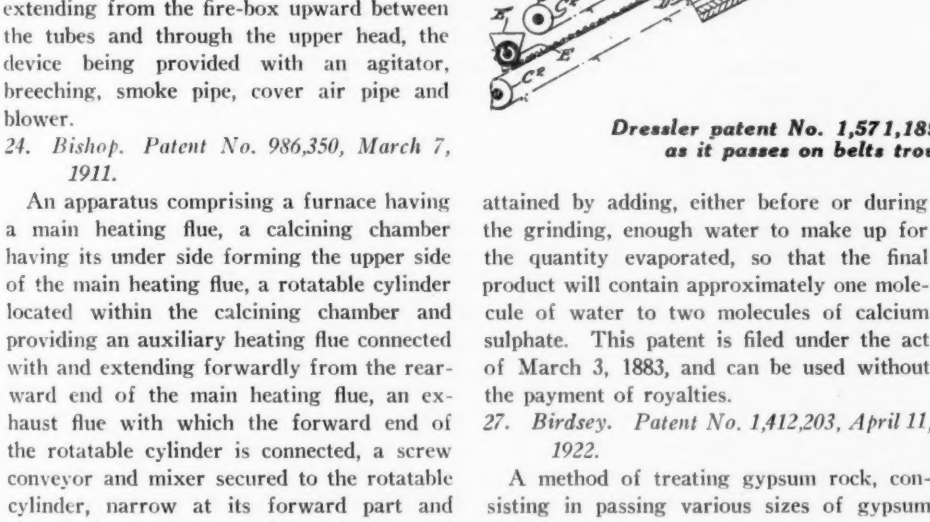
The invention has for its principal object to provide a construction of multiple kettle calciner in which there is a novel association and combination with the main calcining kettle of one or more preheating kettles arranged for intercommunication at proper times; said arrangement of kettles being further combined with a furnace structure provided with means whereby the products of combustion, after operatively passing through the main calcining kettle, and conducted successively through the preheating kettles; all to the end that a more rapid handling and treatment of the raw material in larger quantities per given time period may be accomplished with a minimum of fuel consumption; the apparatus utilizing the heat of waste products of combustion, which is the ordinary single calcining kettle, is lost by discharge through the furnace stack.



Dressler patent No. 1,571,189. Calcination of gypsum as it passes on belts trough a drying chamber

30. *Journet. Patent No. 1,449,326, March 20, 1923.*

The kiln comprises, in general, two cylindrical kettles on horizontal axes, placed one above the other in one and the same furnace, each of which revolves slowly in a contrary direction from the other; interiorly the kettles are provided with helical wings for mixing the material and driving it towards the outlet situated in one of the ends of each kettle. The upper kettle is intended for drying the plaster-stone or plaster by the utilization of the hot gases derived from the furnace which heats the lower kettle in which the



Haire patent No. 1,457,161. Tube mill in which calcined gypsum is ground to produce plastic gypsum

burning operation takes place.

31. *Haire. Patent No. 1,457,161, May 29, 1923.*

The method of making plastic gypsum, consisting in passing calcined gypsum through a tube mill with substantial exclusion of air in circulation through said mill to thereby prevent loss of the water content during the grinding, the material being allowed to discharge at the periphery of the mill when the desired degree of plasticity is reached.

32. *Stuart and Rivers. Patent No. 1,463,-913, August 7, 1923.*

A process of dehydrating gypsum which consists in subjecting rock gypsum to steam pressure at approximately 150 lb. for a period of approximately four hours, then shutting of the steam and after a reduction of the steam pressure by condensation, blowing of the remaining steam.

33. *Edwards. Patent No. 1,548,358, August 4, 1925.*

The method of producing plaster of Paris which comprises treating the acidulous by-product calcium sulphate slurry, from the manufacture of phosphoric acid by metathetically combining the sodium of a basic sodium salt with the acid radical to form a sodium salt of the acid.

34. *Dressler. Patent No. 1,571,189, February 2, 1926.*

An apparatus for calcining gypsum by the use of hot air flowing through a drying chamber through which the gypsum is continuously carried, as by means of a suitable belt conveyor or conveyors.

35. *Gerlach. Patent No. 1,634,459, July 5, 1927.*

The process of making a plaster material containing about 70% calcium carbonate and calcium oxide and 30% calcium sulphate hemihydrate, which comprises treating hot, freshly burnt crushed limestone with sulphuric acid of such concentration and in such quantity that a part of the burnt limestone is converted directly by the heat of the reaction into calcium sulphate hemihydrate without the addition of external heat.

36. *Colton. Patent No. 1,659,971, February 21, 1928.*

A process of calcining gypsum, which comprises calcining raw gypsum in the presence of borax at a temperature sufficient to reduce the water content to between ½% and 1%, then adding gypsum to the calcined material and then recalcining at a lower temperature to produce an artificially aged casting plaster which is capable of immediate use. After the addition of the raw gypsum, the material is further calcined, preferably until the residual water is suitably reduced, for example, from 4% to 6%. This operation should normally not exceed in temperature the temperature of the end point of a normal first boiling operation, that is, about 340 deg. F.

Wall Plaster, Wall Board and Floor Composition Production in 1927

THE DEPARTMENT OF COMMERCE accounces that, according to data collected at the biennial census of manufactures taken in 1928, the establishments engaged primarily in the manufacture of wall plaster, wall board, and floor composition in 1927 reported products valued at $83,856,008, a decrease of 7.8% as compared with $90,957,045 for 1925, the last preceding census year. Among the principal items making up the total production are the following: Gypsum wall plaster, 4,188,704 tons, valued at $31,892,534; wall plaster, other than gypsum, 111,512 tons, $3,171,955; gypsum board, 929,954,714 sq. ft., $20,222,353; fiber and other wall board, including insulating board, 403,653,834 sq. ft., $15,718,661; and floor compositions, $2,851,214.

The establishments in this industry are engaged primarily in the manufacture of gypsum and other wall board and wall plasters insulating board and floor composition. (Establishments engaged in making wall and insulating board from wood pulp are classified in the paper industry, and therefore no data for products made in such establishments are included in this report.)

Of the 221 establishments reporting for 1927, 41 were located in New York, 35 in California, 17 in Illinois, 13 in Michigan, 11 in Iowa, 11 in Ohio, 9 in New Jersey, 8 in Pennsylvania, 7 in Washington, 6 in Texas, 5 in Maryland, 5 in Minnesota, 4 in Kansas, 4 in Missouri, 3 each in Colorado, Kentucky, Massachusetts, Nevada, Oklahoma and Wisconsin, and the remaining 27 in 18 other states. In 1925 the industry was represented by 222 establishments, the decrease to 221 in 1927 being the net result of a loss of 59 and a gain of 58. Of the 59 establishments lost, 30 went out of business prior to 1927, 7 were no longer engaged in manufacturing, 7 were idle throughout the year, 6 reported commodities other than wall plaster, wall board and floor composition as their principal products and were therefore transferred to the appropriate industries, and 9 reported products valued at less than $5000. (No data are tabulated at the biennial censuses for establishments with products under $5000 in value.) Of the 58 establishments gained, 2 were idle throughout the year 1925, 4 had reported products valued at less than $5000 for 1925, 5 manufactured other classes of commodities as their principal products in 1925, and 47 reported for the first time at the present census.

TABLE 1.—SUMMARY FOR THE INDUSTRY: 1927 AND 1925

	1927	1925	Per cent of increase (+) or decrease (—)
Number of establishments	221	222	— 0.5
Wage earners (average for the year)*	10,014	10,978	— 8.8
Wages†	$14,411,777	$16,078,362	—10.4
Cost of materials, mill supplies, fuel and purchased power, total†	$31,998,385	$39,553,463	—19.1
Materials and supplies	$26,915,238	(‡)	....
Fuel and power	$ 5,083,147	(‡)	....
Products, total value†	$83,856,008	$90,957,045	— 7.8
Wall plaster, wall board, and floor composition	$73,856,717	(§)	....
All other products¶	$ 9,999,291	(§)	....
Value added by manufacture‖	$51,857,623	$51,403,582	+ 0.9
Horsepower	116,231	82,863	+40.3

*Not including salaried employes.
†The amount of manufacturers' profits cannot be calculated from the census figures, for the reason that no data are collected in regard to a number of items of expense, such as interest on investment, rent, depreciation, taxes, insurance, and advertising.
‡Not reported separately.
§No comparable data for 1925.
¶Gypsum blocks, 62,833,561 sq. ft., valued at $3,637,131; gypsum rock, 655,634 tons, $1,709,221; and miscellaneous products, $4,652,939.
‖Value of products less cost of materials, mill supplies, fuel and purchased power.

TABLE 2.—PRODUCTS, BY KIND, QUANTITY, AND VALUE: 1927*

	Quantity	Value
Aggregate value	....	$73,856,717
Wall plasters, total (tons)	4,300,216	35,064,489
Gypsum plasters, total (tons)	4,188,704	31,892,534
Neat plaster (tons)	2,423,785	18,080,543
Sanded plaster (tons)	554,673	4,143,818
Stucco (tons)	648,953	3,819,770
Molding, dental, and gaging plaster (tons)	204,462	2,301,301
Finishing plaster (tons)	144,998	2,042,223
All other gypsum plaster (tons)	211,833	1,504,879
Other plasters, total (tons)	111,512	3,171,955
Portland cement stucco (tons)	34,839	1,086,172
Magnesite stucco (tons)	29,591	1,014,413
All other (tons)	47,082	1,071,370
Wall board, including insulating board, total (sq. ft.)	1,333,608,548	35,941,014
Gypsum board, total (sq. ft.)	929,954,714	20,222,353
Wall board (sq. ft.)	658,780,359	15,929,492
Plaster board (sq. ft.)	224,205,056	3,594,681
Gypsum lath (sq. ft.)	46,969,299	698,180
Fiber and other wall board, including insulating board (sq. ft.)	403,653,834	15,718,661
Floor composition, total	....	2,851,214
Magnesite	....	2,071,524
Premixed concrete or cement	....	129,405
All other	....	650,285

*No comparable data for 1925.

Factors Affecting the Dissolution Rates of Limestone in Acid Media

With Particular Reference to the Industrial and Agricultural Values of Different Limestones

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WITH THE INCREASING USE of limestone in the industries, the factors affecting the rate of dissolution of limestone are assuming practical as well as academic interest. A great mass of literature has appeared on the commercial uses of lime and limestone, but the number of published investigations bearing on the specific differences of limestones and the conditions controlling the rate of dissolution is small. Noteworthy among the contributors to the agricultural phases of the subject are Ames and Schollenberger (1), Barker and Collison (3), White (22), MacIntire and Shaw (15), Hopkins (10), Frear and Thomas (7) and Stewart and Wyatt (20). Their reports of observations of field, small plot and pot tests indicate that fineness is of considerable importance, but their recommendations regarding the degree of fineness desirable in the treatment of acid soils, etc., vary widely. The relative inefficiency of the coarser sizes of limestone particles has been reported, it having been observed that limestone chips lie almost unaltered through long periods in contact with acid soils. Hager and Kern (8) showed that the origin and specific character of limestone may affect its solubility in solutions of carbon dioxide. Morgan and Salter (17) found that the physical properties of limestone, such as hardness, porosity, crystallinity and density were not safe indices of their dissolution rates in acid soils and in acetic acid solutions. The factor most seriously altering the normal solubility of such material was observed to be the magnesium carbonate content; in general the higher the percentage of magnesium carbonate the slower the dissolution.

The factors of greatest importance to the rate of chemical reactions, such as limestone dissolving in an acid solution, are acid intensity, diffusion, surface exposed to reaction and temperature. The other conditions being kept constant, the rate of dissolution of limestone in an acid medium is governed by the amount of surface exposed. If the amount of surface can be determined, it is possible to predict from a dissolution study of this surface the amount of material which would pass into solution under similar conditions from other surfaces of the same composition.

(A) Surface Versus Size of Particles: The relationship between the surfaces and the dimensions of particles of any *regular* shape is a constant for all sizes of that shape. Hence, it follows that a knowledge of the dimensions of such particles may serve in place of a determination of their surfaces. For an irregularly shaped particle, such as a fragment of limestone as it comes from the crusher, one may doubt that the same irregularities persist in kind and degree as the particle is reduced in size by mechanical means. However, the assumption can be made, for relative purposes, that the factor between the average linear dimension or diameter and the surface of a particle will not change materially as the particle is reduced in size. The validity of this assumption was tested in the following manner, with crystalline material, such as calcite, and with limestone to which no regular crystal habits could be ascribed.

From hand specimens which appeared to be uniform were taken pieces that were large enough to be convenient for grinding and polishing on the lap and oilstones. Regular geometric figures whose surfaces could be accurately measured with a micrometer were worked out. It was attempted to follow as much as possible the most evident cleavage and fracture planes of the limestone chosen since shape would affect the relation between the weight and the exposed surface. Several pieces so fashioned were measured carefully for their total surfaces exposed, weighed and subjected to an acid solution under uniform agitation and constant temperature for a definite period. From the loss in weight found, the rate of dissolution per unit of surface could be calculated for each material.

The remaining portion of each original hand specimen was then reduced in a jaw crusher and screened according to the Tyler standard screen scale into the following separates, in meshes per inch—3, 4, 6, 8, 10, 14, 20, 28, 35, 48, 65, 100, 150 and 200. In the following table are given the average diameters of particles of each separate and the increases in surface corresponding to the several screen sizes.

From the values given in Table 1, it will be seen that the average diameter of particles of one separate is 1.414 (square root of 2) times the average diameter of particle of the next finer separate. If the shape of the fragments remains essentially the same, the total surface of a given weight of particles from one separate must be multiplied by this same factor (1.414) to equal the total surface of the same weight of particles from the next lower separate.

TABLE 1—SCREEN MESH IN RELATION TO THE DIAMETERS AND SURFACES OF CORRESPONDING PARTICLES

Mesh of screen	Opening in inches	Average diameter of separates	Increase of unit surface
3	0.263		
		0.224	1.0
4	0.185		
		0.158	1.414
6	0.131		
		0.112	2.00
8	0.093		
		0.079	2.828
10	0.065		
		0.056	4.00
14	0.046		
		0.0394	5.656
20	0.0328		
		0.028	8.00
28	0.0232		
		0.0198	11.312
35	0.0164		
		0.0140	16.00
48	0.0116		
		0.0099	22.624
65	0.0082		
		0.0070	32.00
100	0.0058		
		0.0050	45.248
150	0.0041		
		0.0035	64.00
200	0.0029		

The separates were freed from adhering dust by washing and by shaking with a gentle current of air moving through the screens. Portions of these separates were then taken equalling the weights of the polished pieces of known total surface. Under the same conditions of acidity, temperature and time, the amounts of material dissolved from the several portions were determined. As the only variable remaining was the surface exposed, this became known for the series of separates. While the conditions of the process had to be modified for the kinds of limestone under test, the following are typical for limestones of high calcium content: A weighed sample was placed in a 300-cc. Erlenmeyer flask containing about 250 cc. of a 0.150 HCL solution, which was also 0.2N with respect to calcium acetate for its buffer effect. The acid present was 100-120% in excess of the limestone samples neutralizing power. The flask was shaken

on a mechanical shaker for 4.5 minutes, the suspension being allowed to settle with slow decantation during the next 30 seconds, after which the reaction was quickly stopped by the addition of 150-250 cc. of distilled water at 0 deg. C. Further decantations and washes with cold water followed until the sample could be safely filtered upon a Gooch filter. After drying and reweighing the Gooch crucible, the per cent loss was determined for each separate. During the dissolution process the temperature was kept at 25 deg. C. ± 0.5 deg.

In the following graph (Chart 1) are shown the curves representing the values of the surfaces derived theoretically by increasing each previous value by the constant factor of 1.414 and those values actually obtained from equal weights of the various screen separates. It is evident that there is no radical departure from the regular relation between the surface and the diameter of a particle of irregular shape, as its size is reduced by crushing. It will be noted that most of the experimental values lie slightly above those calculated. This is what we may expect since the theoretical values of the surfaces are the least which can be obtained under given conditions of progressive decrease in dimension of the particles. The normal departure from this would mean greater irregularity and hence greater surface exposure.

The curve "DLP" is seen to follow the calculated curve quite closely until the 35- to 48-mesh separate is reached, and here a break occurs followed by a slowly rising trend. It is hardly to be supposed that there is a sudden deviation from the surface increase with decreasing size, particularly not with this specimen, since it is a well crystallized limestone of moderate magnesium carbonate (23%) content. The interpretation lies rather in the fact that the material is not homogeneous, and that selective dissolution is taking place. The break in the surface curve indicates that the readily soluble portion has been dissolved from the exposed surface and that further solution must necessarily be from the more slowly soluble constituent. This matter of selective solubility will be discussed later.

Since this method of studying the surface-size relationship of irregular limestone particles was developed, a similar method has been published by Martin, Bowes and Christelow (16). The surfaces of silica sand separates produced during grinding were determined by the loss in weight in hydrofluoric acid solutions. Very satisfactory results are credited to this procedure.

(B) Effect of Size Upon the Dissolution Rate: Method I.

Having established the persistence of the surface-size relationship of irregularly shaped limestone particles through the sizes from 4- to 150-mesh, it was possible to proceed to the study of the rates of dissolution of limestone particles in acid media. The first apparatus used consisted essentially of a reaction chamber containing an acid solution and the sample, an absorbing electrolyte for the evolved carbon dioxide, a constant temperature bath, and the electrical apparatus needed for making conductivity measurements of the absorbing electrolyte. As the study included 13 screen separates, the apparatus was made in multiple so that seven sizes could be run simultaneously, one separate being run again in the next series to serve as a check test.

The reaction chambers used were gas-scrubbing towers of 275-cc. capacity fitted with ground glass joints. They were charged with 250-cc. of a saturated solution of succinic acid ($COOH \cdot CH_2 \cdot CH_2 \cdot COOH$), to which had been added 3 g. of calcium succinate per liter for its buffer effect. This acid was chosen because it provided a solution of moderate acidity (3.24 to 3.27 pH at 25 deg. C.), whose acid intensity could readily be kept constant because of its low solubility (6.8 g. per 100 cc. at 20 deg. C.). One gram portions of the limestone separates were placed in the reaction chambers. The carbon dioxide liberated by the reaction with the succinic acid was led under reduced pressure (0.5 atmosphere) into absorption electrolytic cells of the Vanier type containing 175 cc. of approximately $\frac{N}{8}$ $Ba(OH)_2$ solution. The electrodes of the cell were platinum wires sealed in Pyrex tubing, the exposed platinum tips being melted back in an oxygen-gas flame to form beads slightly over 1 mm. in diameter. The bead-tips were platinized by immersing them in a platinic chloride solution while a direct current of six volts was passed between them, the current being reversed every half minute for four minutes. The original conductivity and concentration of the $Ba(OH)_2$ solution of each cell having been determined, any change produced therein by the absorption of CO_2 and the precipitation of $BaCO_3$ could be traced by conductivity measurements.

For this purpose the apparatus consisted of a Leeds and Northrup Kohlrausch slide wire, a microphone oscillator of 1000 frequencies, a fixed resistance box of 1 to 9999 ohms capacity, head phones, rheostat, 6-volt battery and a 7-way distributor.

As shown in the accompanying diagram (Fig. I) the reaction chambers and cells were immersed in a thermostat bath, the temperature being maintained at 25.0 deg. C. ± 0.1 deg. The gas train was swept by a current of air purified by a saturated $Ba(OH)_2$ solution. The rate of air passage through the system was 250 cc. per min., this being sufficient to keep the solutions in gentle agitation. Before a run was begun, air was drawn through the apparatus for 30 min. to allow the conductivity cells to reach an equilibrium.

To standardize the cells and to coordinate the resistances found with the amount of limestone dissolved, two methods were employed. The first consisted of placing 1 g. of pure precipitated calcium carbonate in 0.2000 g. portions in the apparatus, the conductivity measurements being made after each addition until the readings became constant. By plotting the observed readings against known weights, intermediate values could be determined. The other method was to dilute the original $Ba(OH)_2$ solution with redistilled water to produce the same decreases in strength which given amounts of pure calcium carbonate yield upon decomposition. As seen in the accompanying graph (Chart 2), plotting the logarithms of the resistance against the logarithms of the normalities of the solution gave parallel straight lines, the initial points depending upon the

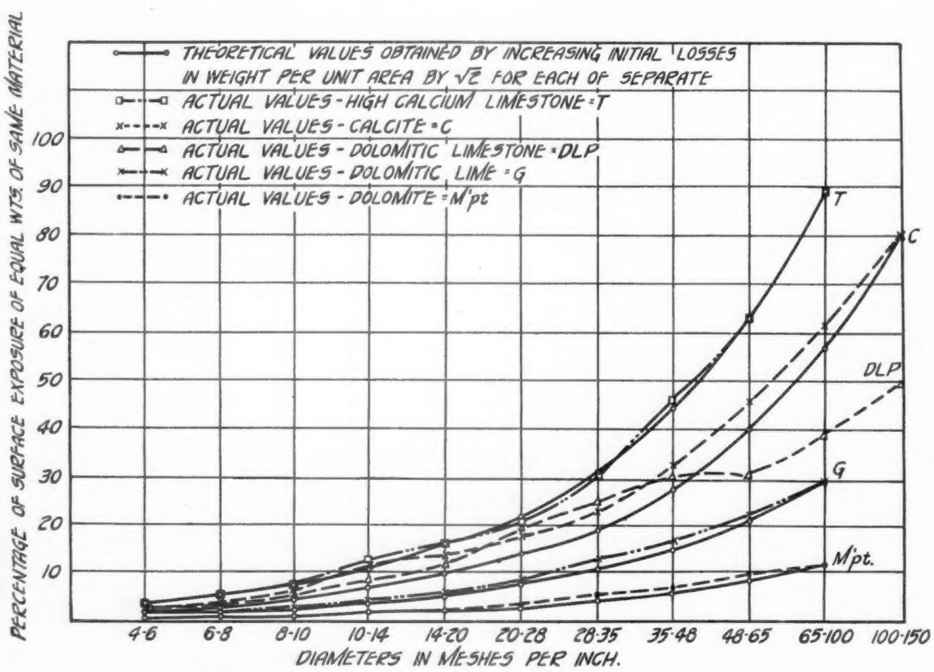

Chart 1. Relation of diameter to total surface of limestone particles

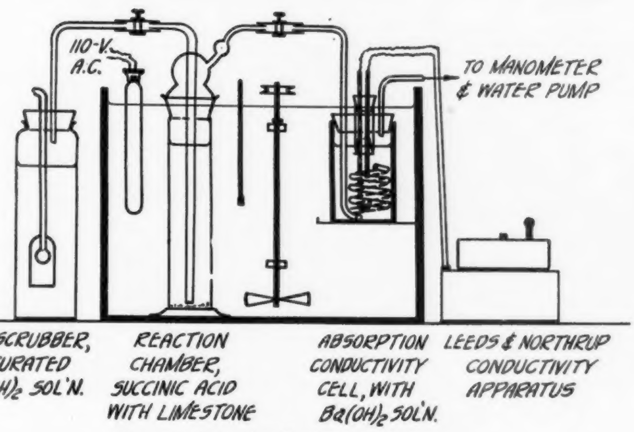

Fig. 1. Conductivity apparatus

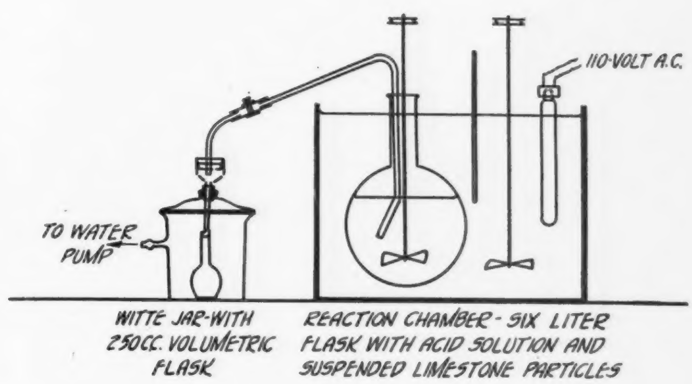

Fig. 2. Dissolution of limestone apparatus

cells constants.

The mathematical expression for the relationship between the resistances observed and the amounts of limestone decomposed may be had from the slope formula:

$$Y_1 - Y_2 = M\ (X_1 - X_2)$$

From the graph we find that the ordinate-abscissa ratio = 0.9395, which value equals M in the above expression. From this we get:

Log. resistance (R) = cell constant (K) 0.9395 log. normality (N)

and log. R_1 — log. R_2 = 0.9395 (log. N_1 — log. N_2)

or log. $\dfrac{R_1}{R_1} = 0.9395\ \dfrac{N_1}{N_1}$ —

or for convenience

$$1.0644 \log. \frac{R_1}{R_2} = \log. \frac{N_1}{N_2}$$

In the work of Cain and Maxwell (4) it was found that the best concentration of $Ba(OH)_2$ solution for the complete and rapid absorption of CO_2 in a combustion train was between 0.20 and 0.25 normal. As rapidity of solution was not of prime importance in the present work, a lower strength of $Ba(OH)_2$ was used, namely 0.1210 normal. In 175 cc. of this solution there are 1.8147 g. $Ba(OH)_2$, equivalent to 1.0599 g. of pure $CaCO_3$. The CO_2 from the decomposition of 0.00875 g. of pure $CaCO_3$ produced a change of 0.001 in the normality of the absorbing solution. While the actual change in the concentration of the absorbing solution for a given amount of CO_2 is the same at all concentrations, the relative change in the normality is very different, the resistances representing absorptions changing relatively much more as the solution decreases in strength. Therefore, the least sensitivity is found at the beginning of the run while the absorbing solution is almost at its original strength. The same inaccuracy in making the resistance measurement which would involve an error 0.44% $CaCO_3$ at the start would cause a difference of but 0.044% $CaCO_3$ when the determination was nearing completion. As the apparatus was sensitive to differences of this order, its accuracy was considered satisfactory for the present problem.

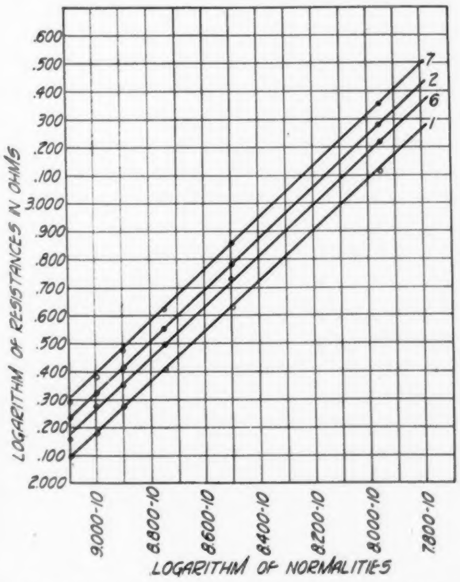

Chart 2. Relation between normality and conductivity of barium hydroxide solution

Three limestone samples were selected for the study of the rate of dissolution under the described conditions. On was a high calcium limestone of the Columbus formation, near Columbus, Ohio, dense, hard, with a splintery fracture. The second was a high magnesium stone approaching the true dolomitic ratio of $CaCO_3$:$MgCO_3$, quite porous and friable, with few visible impurities.

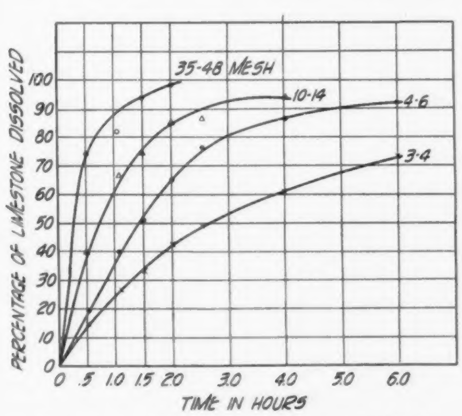

Chart 3. Dissolution rate of high calcium series in saturated succinic acid

This stone was taken from the Niagarian formation, near Carey, Ohio. A large crystal of calcite was the third sample, which was taken as a standard for comparison. Composite samples of the three materials showed the following composition:

TABLE 2—COMPARISON OF CHEMICAL ANALYSES

	High calcium %	High magnesium %	Calcite %
Loss on ignition	39.40	46.51	44.28
Silica	7.07	0.25	0.10
Alumina	1.72	0.15	0.02
Ferric oxide	2.27	0.17	0.20
Calcium oxide	47.45	31.23	54.36
Magnesium oxide	1.19	21.42	0.84

The results obtained in this solution study are shown in the accompanying graphs (Charts 3, 4 and 5).

It will be seen that the type af curves shown is hardly that of normal solution under constant conditions. There is a slight tendency of the curves to flatten out in some cases. This may be accounted for in part by the time which elapsed between the instant of CO_2 formation at the surface of the limestone in the acid medium and the final

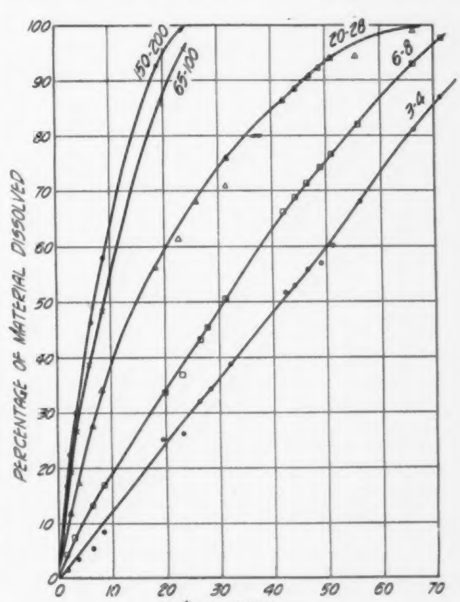

Chart 4. Dissolution rate of a high magnesium limestone in succinic acid

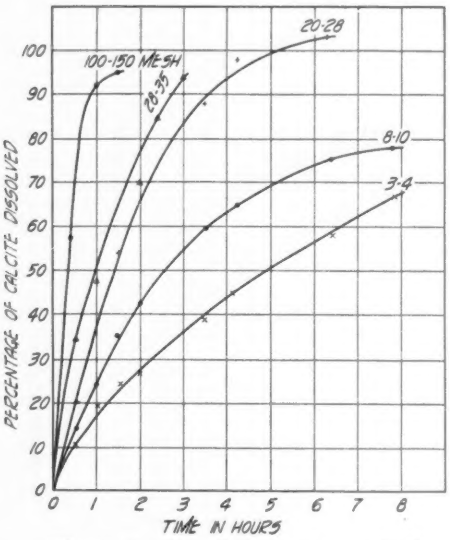

Chart 5. Dissolution rates of the calcite series in saturated succinic acid solution

absorption of the gas in the cell. The effect could not have been great, however, judging from the regularities of the short-time runs. The most pronounced deviations from the expected type of curve must be attributed to the limestones themselves. It was noted that some of the samples disintegrated in the acid media into many smaller particles instead of dissolving uniformly as unit pieces. Such a process materially affected the dissolution rate through the exposure of a much greater surface area. The larger particles profited more by this than did the smaller sizes, especially if there was a definite size below which the grosser particles did not disintegrate readily. This effect was noted frequently, the dissolution rate of the larger separates being relatively too high from theoretical considerations.

During the early stages of dissolution this effect was not felt, hence the values obtained during this time are found to agree quite closely with the straight line relation between the logarithmic values of both dissolution rate and size of particle. It follows, therefore, that the time of dissolution of limestone particles depends upon their diameters. A particle two units in diameter requires twice as much time for its complete dissolution as does a particle of unit diameter under the same conditions.

Method II.

In order to study the rates of dissolution of limestone particles in acid solutions more quickly and with apparatus that can be obtained easily in a general laboratory, the following plan was adopted: A weighed quantity of the screened separate to be studied was placed in a dilute acid solution and kept in agitation until solution was complete. At definite intervals portions of the suspension were withdrawn in such a manner that the remaining liquid and solids were not disturbed in their relative proportions. The withdrawn portions were rapidly filtered and titrated for the acid remaining, the process of neutralization being followed in this manner in successive portions.

The apparatus (Fig. 2) consisted of a 6-liter flask immersed in a constant temperature bath. The flask was equipped with a stirrer driven at 1060 r.p.m., this rate being sufficient to keep the solution and suspended limestone in a quite uniform state of distribution throughout the flask. A measured volume (usually 4.5 liters) of 0.150N. HCl was placed in the flask. The solution contained enough calcium acetate to be 0.20N. with respect to this salt. When the contents of the flask reached the desired temperature of 25 deg. C. $\pm$ 0.10 deg., a weighed sample of a limestone separate was admitted to the flask, a decimal stopwatch being started simultaneously. The amount of limestone added was the calculated equivalent of one-half the total acid present. In a Witte jar was placed a 250-cc. volumetric flask having the neck cut off to deliver exactly 250 cc. when filled to capacity. The jar top was fitted with a small Büchner funnel provided with strong rapid filter paper and a large one-hole stopper. The delivery tube connecting this with the solution in the flask was of 6 mm. bore. This tube was adjustable as to the depth of immersion in the reacting solution, being kept at the middle (vertically) of the volume of the liquid. At carefully timed intervals the pressure in the Witte jar was reduced by a water pump and a quantity of liquid and solid material was brought over upon the Büchner funnel. Since this was truly representative of the suspension at the time it could be removed without disturbing the liquid-solid ratio of the remainder. The time of filtration was 15 to 20 seconds. The contents of the 250 cc. flask were transferred to a 500 cc. Erlenmeyer flask, heated to just 95 deg. C. while being stirred with a thermometer, and titrated while hot against standardized 1.000N. sodium hydroxide solution, phenolphthalein being used as the indicator. The amount of acid neutralized in a given time was then calculated to the per cent of limestone dissolved.

The samples used in these tests were hand specimens selected to fairly represent single stratifications of limestone as to uniformity, color and texture. These were then crushed and screened as before and carefully cleaned of adhering dust. After the rate of dissolution determination had been made on a number of separates of each sample selected to give a wide range of sizes, composites of separates were made to determine if the per cent dissolving from such a composite was equal to the sum of those from the component separates. This was found to be the case. The dissolution curves are shown in the following graphs (Charts 6, 7, 8, 9 and 10). The composites indicated are composed of equal parts of the same material of these sizes—20 to 28, 48 to 65 and 150 to 200-mesh.

The types of curves obtained by plotting the percentages of limestone dissolved against the time of solution are about in accord with the theoretical considerations. Again the relation between the logarithms of the solution rates during early periods and the logarithms of the diameters of the particles involved is found to be linear (Chart 11). From a knowledge of the diameters of limestone particles it is therefore possible to predict the amount of material becoming available during any period from each of the particle sizes. The time required for the complete dissolution of a limestone particle can be predicted from the knowledge of the dissolution rate of any other sized particle of the same material. Similar observations were made by Haslam, Adams and Kean (9) in their recently published work on the rate of dissolution of commercial lines.

One sample marked "Dolomitic LP" (Chart 8) represents the type of limestones in which incongruous dissolution has its most pronounced effect. From the curves giving its dissolution behavior it will be seen that approximately 60% of its weight became available almost as quickly as did the pure calcite particles of the same mesh. During the remainder of its dissolution its curve corresponds closely with that found for dolomites, such as the sample marked "Dolomite SL" (Chart 9). This behavior is explained more fully under the selective solubility tests described later. The 23% $MgCO_3$ contained in this material seems to be held entirely as the double carbonate of calcium and magnesium, the remaining part of the mixture being calcite. Microscopic examination of the residues from the several portions taken indicate this same presence of dolomite and calcite *mixed* since the least dissolved mineral grains were the ones of high refractive index—ranging from 1.675 to 1.68. Many of the crystals retained their sharp outline and unaltered appearance after the greater mass of material had passed into solution.

(C) Composition and Dissolution Rate

The observation that larger particles of dolomitic limestones tended to disintegrate rather than to dissolve as units when in contact with acid media suggested a lack of homogeneity in the material. A *homogeneous* compound or combination of the $CaCO_3$ and $MgCO_3$ in limestones should pass into solution congruently in the presence of an excess of the solvent, provided the solubility of the salts formed would not affect too largely the primary solution reactions. As the matter of congruent or incongruent solution materially affects the dissolution rate of dolomitic limestones from the standpoint of unit particles, the following tests were conducted to determine if selective solubility of the carbonates takes place:

On the first test, three 10-g. portions of a dolomitic limestone of 3 to 4-mesh size were weighed out, the pieces being chosen for ap-

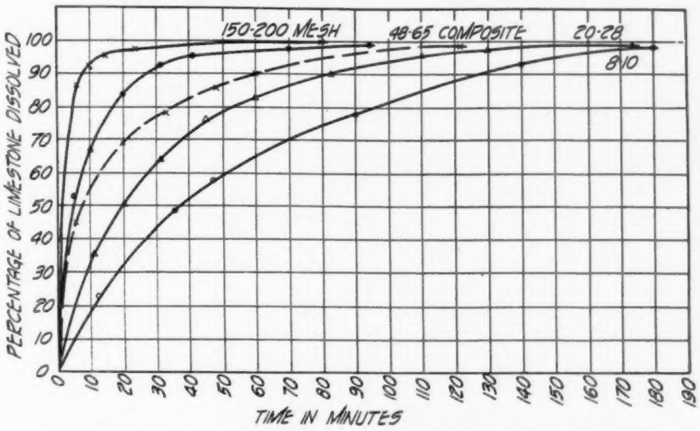

Chart 6. Rate of dissolution of high calcium in dilute solution of hydrochloric acid

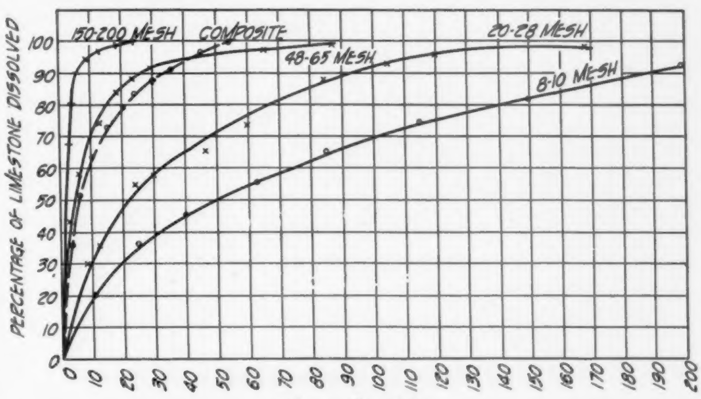

Chart 7. Rate of dissolution of "T" limestone series in dilute buffered solution of hydrochloric acid

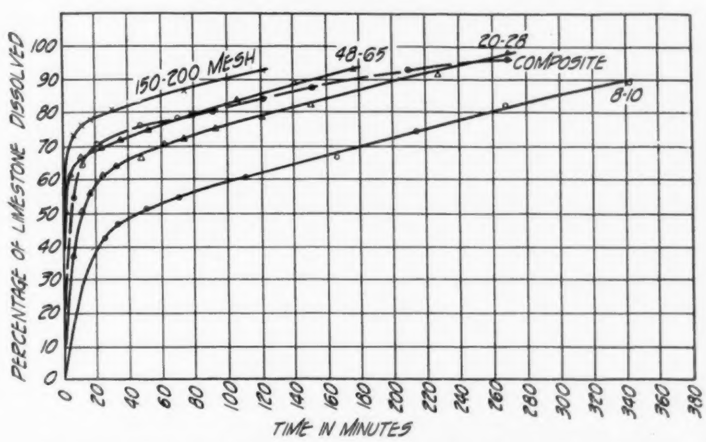

Chart 8. Rate of dissolution of dolomitic "L. P." in dilute buffered solution of hydrochloric acid

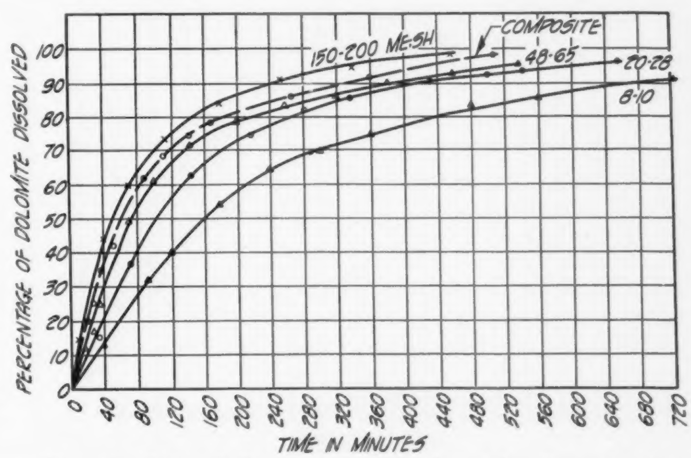

Chart 9. Rate of dissolution of "S. L." dolomite series in dilute buffered solution of hydrochloric acid

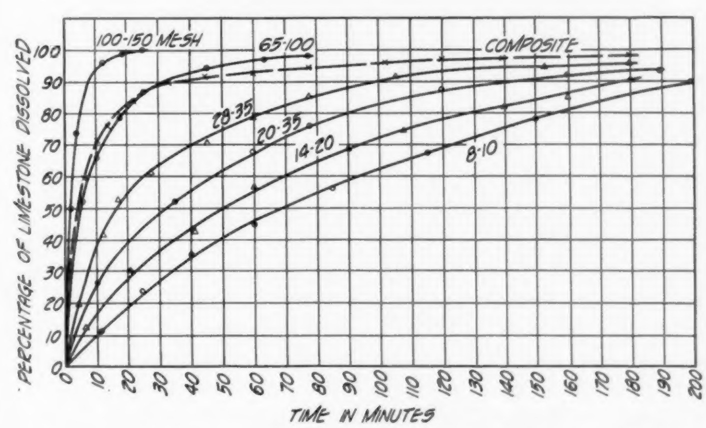

Chart 10. Rate of dissolution of calcite series in dilute buffered solution of hydrochloric acid

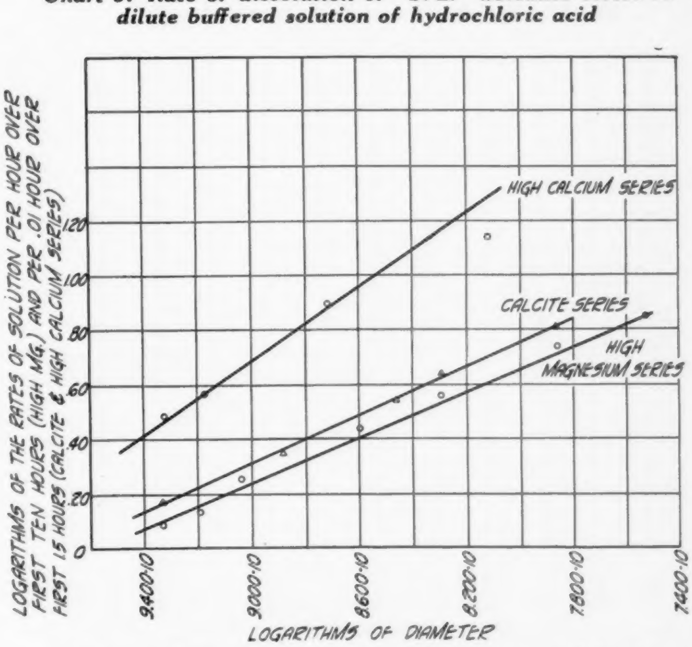

Chart 11. Rate of dissolution of limestone particles in relation to their diameters

parent uniformity. The samples I, II and III were placed in these respective solutions —250 c.. of 0.205 HCl, 500 cc. of 0.1025 N. HCl and 1000 cc. of 0.0501 N. HCl at room temperature and with occasional shaking. After stated intervals these solutions were filtered through Büchner funnels and washed twice by decantation. The residues which were caught on the filter paper were returned to the flasks and other portions of the acid solutions, like the first solvents, were added. The filtrates were evaporated to convenient volume and the calcium and magnesium were determined in the usual manner, observing the precautions of double precipitation of the calcium oxalate, etc. The results are given in Table 3 at the left.

TABLE 3—DISSOLUTION OF $CaCO_3$ AND OF $MgCO_3$ FROM DOLOMITIC LIMESTONE IN DILUTE HCl

	1 $CaCO_3$·$MgCO_3$	II $CaCO_3$·$MgCO_3$	III $CaCO_3$·$MgCO_3$
Solution A (1.5 hr.)	2.289	1.289	2.509
Solution B (1.83 hr.)	1.641	1.265	1.563
Solution C (1.75 hr.)	1.495	1.228	1.253
Solution D (15.5 hr.)	1.297	1.544	1.255
Solution E (192.0 hr.)	0.898	1.330	1.178
Total	1.487	1.349	1.269

In Series I and II selective solution of $CaCO_3$ has occurred, with an enrichment of the residues in $MgCO_3$. In Series II this tendency is not apparent. It will be noted,

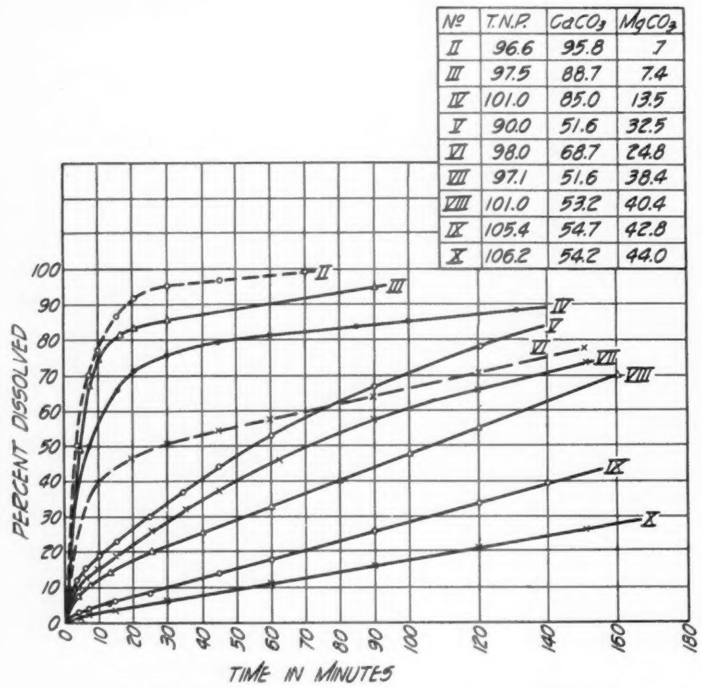

Chart 12. Rate of dissolution of limestone

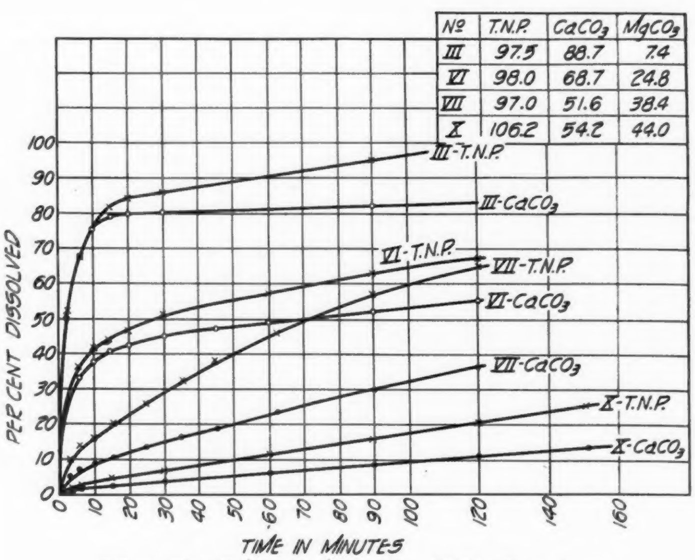

Chart 13. Neutralization of acid by limestone

however, that the value of the total carbonate ratio decreases with decreasing concentration, as would be expected if a *mixture* of $CaCO_3$ and $MgCO_3$ were in contact with the acid solution.

Using 250 cc. of a saturated solution of succinic acid at 25 deg. C. for 24 hours, the following values were found for the $CaCO_3$:$MgCO_3$ ratios of the material dissolved from 4-mesh particles of a series of dolomitic limestones and dolomites:

TABLE 4—PARTIAL AND COMPLETE DISSOLUTION IN SATURATED SUCCINIC ACID SOLUTION

Limestone used	High magnesium dolomite A	Dolomitic limestone	Dolomite L	Dolomite B
$CaCO_3$:$MgCO_3$ from partial solution	1.228	5.979	1.237	1.313
$CaCO_3$:$MgCO_3$ from complete solution	1.205	3.479	1.019	1.209

In each case the partial solution contained a higher proportion of calcium to the magnesium present than did the complete solution of these materials.

In order to effect a more complete separation of the fragments falling off a large particle of limestone during dissolution, this plan was followed: Particles of 3- to 4-mesh were suspended in baskets made of glass rods, with sufficient space between the rods to permit particles of 10-mesh or smaller to fall through. The acid solution was contained in a beaker, the lower half of which was filled with a mixture of carbon tetra-chloride and ether having a specific gravity of 1.155. This mixture practically prevented further solvent action on the fallen particles. It was necessary to keep the contents of the beaker gently stirred to overcome the tendency of the dropping fragments to remain at the contact surface between the liquids and thus remain exposed to the acid solution. The average results obtained by this method, using 2 g. of 4-mesh chips of a finely crystallized dolomitic limestone immersed in 200 cc. of 1.10N. HCl for 40 minutes, follow:

TABLE 5—THE SELECTIVE SOLUBILITY OF THE MINERAL CONSTITUENTS OF A DOLOMITIC LIMESTONE, AIDED BY MECHANICAL SEPARATION

	Partial solution	Residue	Complete solution
$CaCO_3$..............	0.6028 g.	0.0357 g.	0.5612 g.
$MgCO_3$..............	0.1201 g.	0.0297 g.	0.1609 g.
$CaCO_3$:$MgCO_3$	5.019	1.201	3.479

The change in composition during partial dissolution is here too marked to be overlooked. It is interesting to note how near the theoretical dolomitic ratio ($CaCO_3$:$MgCO_3$) of 1.186 the composition of the residual fragments comes. The index of refraction of this residue was 1.678-1.680, corresponding closely with that of dolomite.

The accompanying results were obtained in another series of determinations, using only half enough acid for complete dissolution.

TABLE 6—THE SELECTIVE SOLUBILITY OF THE CONSTITUENTS OF MAGNESIUM CONTAINING LIMESTONES IN SEVERAL ACID SOLUTIONS

Acid used		Dolomitic limestone	"High magnesium" dolomite A	Dolomite L
		——	$CaCO_3/MgCO_3$	——
HCl—	.1032 N.....	5.286	1.323	1.134
Acetic—	.1030 N.....	46.776	1.110	1.266
Acetic—	.2573 N.....	63.894	1.188	1.173
Succinic—	.1040 N.....	38.724	1.369	1.219
Succinic—	.2618 N.....	41.049	1.176	1.202
Samples true ratio....		3.479	1.205	1.019

It will be noted from the foregoing data that the limestone approaching true dolomites in composition suffer only slight changes in their $CaCO_3$:$MgCO_3$ rating during partial dissolution. In the case of the moderately dolomitic limestone, however, a marked difference is found in the dissolution rates of their mineral constituents. The greatest difference in the selective solubilities of the carbonates of one dolomitic limestone (original $CaCO_3$:$MgCO_3$ ratio being 3.479) is in 0.2573 N. acetic acid, where the ratio rises to nearly 64.0. In all cases with this stone there is such a marked difference in the rates of dissolution of $CaCO_3$ and of $MgCO_3$ contained therein that the classing these carbonates as in a homogeneous combination or in solid solution does not seem in accord with the facts. It would seem more reasonable to consider this limestone a mixture of a calcium carbonate form with another containing both calcium and magnesium carbonates, perhaps as dolomite.

In several of the limestones studied the presence of considerable masses pyrite could be established microscopically. It was rather surprising to notice that appreciable amounts of iron passed into solution in competition with the alkaline earth carbonates, later to be largely thrown out of the decreasingly acid solution. The deposition occurred largely on the surface of the chips. This indicates that a limestone particle in soils containing much iron in solution could soon be coated with iron hydroxides or basic salts, resulting in its own elimination from further reaction for a while. Also a highly ferruginous limestone might in a short time become useless as a means of correcting the acidity of soils or of other solutions.

In view of the above observed specific differences in limestones with respect to their dissolution tendencies in acid media, any information regarding the state and association of the chief constituents of these materials should be of interest in interpreting results obtained from rate of solution studies. The literature describes three definite forms

of calcium carbonate, namely, calcite, aragonite, and the hexa-hydrate. Another possible form (gamma-$CaCO_3$) is mentioned, but its instability prevents its occurrence anywhere but under carefully controlled conditions. Aragonite is less stable than calcite, changing into calcite in situ, and hence is less widely found. The solubility of pure aragonite is slightly greater than that of calcite. In the limestone used in these solution studies no aragonite was found using Cole and Little's (6) modified cobalt nitrate solution method.

Of the methods which have been suggested for determining the state of combination of the principal carbonate minerals in limestones, the one developed by Marsten (12) has been most widely adopted. Using dilute acetic acid at temperatures near 0 deg. C. he was able to separate pure dolomite from limestone containing as little as 2% $MgCO_3$ by the more rapid solution of the calcitic material. This suggests a mixture of dolomite and calcite in such specimens. Roth (19) and Hunt (11) likewise found the method adaptable to the separation of the calcitic material from the dolomite, as well as dolomitic material from magnesite at higher temperatures. Vesterberg (20) using 1% acetic acid solutions at 0 deg. C. in 25% excess of the equivalent amount for two-hour periods obtained residues closely approaching dolomite from a number of limestones containing magnesium. Retgers and Brauns (18) from similar results state that "there can be no rule of true isomorphism between the double salt $(CaMg).CO_3$ and the component simple carbonates, also not between calcite and magnesite." A number of qualitative tests have been suggested to distinguish the simple from the double carbonates of calcium and magnesium. Perhaps the best is that produced by Lemberg (14) using $AlCl_3$ solution and haematoxylin (logwood extract) to produce violet coloration on calcite and none on dolomite or magnesite after boiling for 25 minutes.

As solution behavior is the most important factor in the formation, alteration and degradation of sedimentary rocks, it is well to point out that some confusion exists in the geological literature regarding the true solubility of $CaCO_3$ and of $MgCO_3$ in water. Rate of dissolution seems to have been mistaken for *total solubility*. Let one quotation suffice—Bain (2) writes: "Since $CaCO_3$, $CaSO_4$, Na_2CO_3, and Na_2SO_4 are many times more soluble than $MgCO_3$, they would remain in solution, allowing a relatively pure precipitate of $MgCO_3$ to form." This statement is clearly not in agreement with the known solubilities, since Landholt-Bornstein (13) quote the solubility of pure $CaCO_3$ in CO_2-free water at 25 deg. C. as being $1.433 \times 10^{-3} - 1.445 \times 10^{-3}$, while that of MgCO is 9.4×10^{-3}. A study of the many analyses of river, lake and sea waters compiled by Clarke (5) shows a much higher concentration of magnesium as compared with calcium in lake and sea waters than in streams. The explanation apparently lies in the *time* the respective waters have had to act upon the adjacent rock. It must therefore be understood that $MgCO_3$ is *more* soluble, though *more slowly soluble*, in water than is $CaCO_3$, under both natural and carefully controlled laboratory conditions.

Not only the presence of $MgCO_3$ in limestone but also its state of combination and its distribution are factors of great significance to the rate of dissolution of a specific dolomitic limestone. Thus with a limestone containing 22% to 23% $MgCO_3$ a high rate of dissolution was observed during the early part of its decomposition, with a decided decrease in the rate during the later stages of the process. The reason for this break in the dissolution curve is found in the results of the following procedure:

Duplicate weighed samples of 150- to 200-mesh material were treated with 25% excess of 1% acetic acid solution at 0 deg. to 3 deg. C. for stated periods. The undissolved residues were collected by rapid filtration on weighed Gooch crucibles, washed, dried and weighed. The filtrates were analyzed in the usual manner for calcium, with these results:

TABLE 7—THE SOLUBILITY OF A DOLOMITIC LIMESTONE IN 1% ACETIC ACID SOLUTION AT 0 DEG. TO 3 DEG. C.

	2.25 hours		4 hours		6.5 hours	
Per cent of residue =	58.80%	59.04%	59.15%	57.67%	58.67%	58.75%
Per cent of $CaCO_3$ in solution =	41.28%	40.46%	41.12%	42.36%	41.01%	41.11%

This indicates that the dissolution of the more quickly soluble calcite in this sample is as complete in 2¼ hours as in 6½ hours, and that a very slowly soluble portion is left. Since the original material contained 22% to 23% $MgCO_3$, which content was practically untouched during solution, the residue had a composition quite closely agreeing with that of Roth's (19) $(3Ca \cdot 2Mg)5CO_3$ "dolomite." Whether or not this is its true state of combination, the above residue, enriched in magnesium during solution, represents a definite portion of this limestone which successfully prevented complete and congruous dissolution of the entire stone under these conditions.

The same test was applied to other samples of limestones used earlier in this study. The time allowed for the reaction was in all cases 4½ hours, the other conditions remaining as in the previous test. As the agreement between duplicate samples was close, only the averages are given here:

As the solution of the calcite was not complete in the time allowed, all of the residual values are somewhat too high. However, the indications are definite enough to characterize the samples. In each case the $CaCO_3:MgCO_3$ ratio in solution is higher than that of the original material. The per cent of residue is indicative of the proportion of each stone in which the calcium is held in a very slowly soluble form under the conditions maintained.

Agricultural Application

Agricultural liming materials have been evaluated on the basis of their total neutralizing power and their fineness. It has been shown in this paper what effect fineness has upon the value of limestone judged by its rate of dissolution. It now appears that chemical and mineral composition must be considered.

In order to determine more definitely what effect the chemical composition has upon the dissolution behavior of limestones and dolomites, samples were taken from twenty sources of agricultural liming materials used in Ohio and adjoining states. These were selected to give as wide a range in chemical composition as possible. The samples were carefully screened, the 48- to 65-mesh being chosen for this dissolution work. The test procedure followed was the same as previously described under Method II. The results, with the nine samples covering the composition range, are given in the two charts following (Charts 12 and 13).

Several facts are apparent in the foregoing charts: *First*, the rate of dissolution of a stone consisting chiefly of calcium carbonate is much higher than is that of a dolomite. *Second*, the dissolution curve of most of the dolomitic limestones consists of two distinct phases—(*a*) a steeply rising straight line produced almost entirely by the calcium carbonate dissolved; (*b*) a much flatter straight line produced by the dissolution of dolomite. This indicates the existence of these two constituents as a mixture and not in combination. For the moderately dolomitic stones as Nos. IV and VI (Chart 12) the breaks in the curves occur at approximately 70% and 40% respectively. No. X, a dolomite, has no break because it has no appreciable free calcite material. *Third*, stones of approximately the same composition need not have similar dissolution curves. This is true for both high calcium and high magnesium stones. Since this characteristic governs the effect which can be produced in an acid soil, it is evident that the specific rate of dissolving any limestone *must be determined*, if its effect is to be compared with that of another stone.

TABLE 8—SOLUBILITY OF LIMESTONES IN 1% ACETIC ACID SOLUTION AT 0 DEG. TO 3 DEG. C. FOR 4.5 HOURS

	Calcite	Dolomite	Dolomite (SL)	Dolomite (SD)	Dolomite (SB)
Per cent residue =	33.66%	93.97%	90.25%	91.01%	88.72%
$CaCO_3/MgCO_3$ ratio in solution =	No Mg found	3.374	1.313	1.319	1.497

Fourth, the neutralizing effect of the moderately dolomitic limestones (10% to 30% $MgCO_3$), may be greater in a given time through their uncombined calcium carbonate alone, than that of a practically pure dolomite of higher total neutralizing power.

Conclusions and Summary

The rate of dissolution of a particle depends upon its surface area. In regularly shaped particles the total surface exposure of a given weight of material is inversely proportional to the diameters or linear dimensions of the particles. Hence, dividing the diameter of a particle by two, doubles the surface area of the mass and doubles its rate of dissolution.

Since any limestone has characteristic fracture and cleavage habits, it may be assumed that these habits will persist through all sizes to which the limestone may be reduced by crushing in practice. Under these conditions, the shapes of the particles during crushing will be generally similar. Therefore, a definite relation should exist between the surfaces and the diameters of irregularly shaped particles of this material.

It was found in this investigation that the relation between the decrease in size and the increase in surface of irregularly shaped particles of limestone upon crushing, is a constant one.

It was found, further, that the rate of dissolution of limestone parties in dilute acid media, is inversely related to the particle size.

The rate of dissolution of a limestone in acid media is specific for that limestone and must be determined as such.

The physical properties, such as crystallinity and harshness, do not indicate the specific dissolution rate of a limestone.

Calcite dissolves more rapidly in dilute acids than does dolomite.

The rate of dissolution of limestone is affected greatly by its composition, especially by its content of magnesium carbonate. In general, the higher this content, the lower the dissolution rate, but not in direct proportion to the $MgCO_3$ content.

Certain exceptions to this general statement were found. Some dolomitic limestones containing 15% to 25% $MgCO_3$ were found to dissolve more rapidly during the first half of their dissolution period than did practically pure calcite and other limestones of high calcium content.

In this investigation the dolomitic limestones observed were shown to be mixtures of the double carbonate of lime and magnesia ($CaCO_3 \cdot MgCO_3$) and $CaCO_3$, with one possible exception, in which the carbonates appeared to be combined as $3CaCO_3 \cdot 2MgCO_3$.

As the dissolution of the more quickly soluble $CaCO_3$ takes place, the residue becomes enriched in its $MgCO_3$ content.

The dolomitic limestone were observed to disintegrate in dilute acids into smaller particles, thus offering new surfaces to the media. As a result, the rate of dissolution of the larger particles of such limestones was somewhat greater than was to be expected from their size.

Under the microscope, the residues from the partial solution of dolomitic limestones were found to consist largely of well defined crystals, showing little dissolution effects. The index of refraction of these almost unaltered crystals was found to be 1.68, corresponding to dolomite. This agrees with their chemical composition.

The rate at which limestone dissolves is an important characteristic and should be considered along with its total neutralizing power and the fineness to which it has been crushed.

It is believed that the observations made in these laboratory investigations can be applied in general to field conditions.

The apparatus and test procedures for each of the following determinations have been described—(*a*) the relation between size and surface of irregular particles; (*b*) the effect of size upon the dissolution rate of limestone particles; (*c*) the effect of chemical and mineralogical composition on the dissolution rate of limestones and dolomites; (*d*) selective solubility studies.

* * *

This opportunity is taken to thank Dr. Firman E. Bear, chairman of the soils department, Ohio State University, for his splendid counsel, guidance and generous cooperation in this work; also to express the deepest appreciation to the members of the National Agstone Association for their continued support which made this investigation possible. The assistance of N. Williams, France Stone Co. Laboratories, in checking some of the data contained herein, is gratefully acknowledged.

* * *

Note: This paper is constructed from Part I of a dissertation presented by Herbert F. Kriege to the Faculty of the Graduate School of Ohio State University in candidacy for the degree of Doctor of Philosophy, 1926, an abstract of which was published in ROCK PRODUCTS, July 10, 1926, pp. 65-67.

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Arundel Corporation Plans Expansion

IN AUTHORIZING a large outlay for new equipment the Arundel Corp., Baltimore, Md., has several large contracts in view. Among these is the contract for dredging in connection with the construction of Baltimore's new airport which is expected to be one of the largest flying terminals in the entire world. Other contracts which may appear on the Arundel books as soon as final plans are completed have to do with the Chesapeake Bay Bridge, the Pennsylvania Railroad's local tunneling, the Pennsylvania Water and Power's hydroelectric project at Safe Harbor, on the Susquehanna River, and flood prevention work on the Mississippi River. While it is understood that the contract for the Chesapeake Bridge has not yet been awarded, it is generally known that the Arundel Corp. was the lowest bidder in connection with dredging for this undertaking and other engineering details.

Stockholders of the company also are interested in developments in Florida now that the legislature in that state is in session, as it is believed likely that provision will be made to pay the Arundel Corp. the $2,300,000 for work completed in the Everglades, settlement of which has been withdrawn on account of legal technicalities. It is believed also that the legislature may authorize completion of the drainage work in that section of the local company.—*Wall Street News* (New York City).

The Wire Saw in Slate Quarrying*

Second Supplementary Report

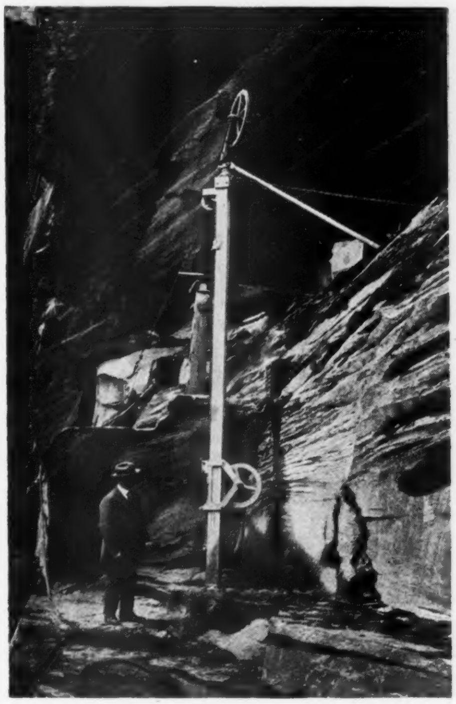
By Oliver Bowles†

THE WIRE SAW, introduced by the Bureau of Mines about two years ago, has revolutionized slate quarrying in Pennsylvania. The success of the saw since its early accomplishments has become greater and greater as the equipment has been perfected and skill acquired in its use. In the first test made, a cutting rate of 9.7 sq. ft. per hour was attained; in the next four cuts, made early in 1927, the average rate of cutting was increased to 12.8 sq. ft. per hour; in 1928 a maximum of 34 sq. ft. per hour had been attained, with a general average of about 20 to 25 sq. ft. The wire saw is now regarded as essential equipment in practically all of the quarries in the Bangor, Pen Argyl and Wind-gap districts.

The wire saw consists of a three-strand steel cable of 3/16- or 1/4-in. diameter running as an endless belt. The driving pulley is a 40-in. double-groove cast-iron sheave. A tension pulley supported by a frame mounted on wheels may travel back and forth on a short track. A weight of 800 to 2,000 lb. gives the desired tension on the wire. The driving units consist of electric motors with direct-drive compactly enclosed gear reduction, or double-belt speed-reduction units; the former is preferred. Silent chain and pinion gear reductions are used to a limited extent. The traveling speed of the wire is about 15 ft. per second. The driving and tension equipment are shown in Fig. 1, *A*.

The equipment in the quarry consists of a pair of standards, each having one or two sheaves at the top for receiving and conducting the wire to a lower sheave which travels up or down by a rope-pull worm gear. The standards are either placed on platforms, over the edges of open benches, or in holes about 10 ft. deep and large enough to accommodate the movable sheaves. The standards are usually set up 60 to 100 ft. apart. By lowering the guide pulleys, the wire is brought in contact with the slate surface and, when fed with sand and water, makes a cut over the entire distance between the standards. The arrangement of the cutting equipment is shown in Fig. 1, *B*. The original equipment had guide pulleys which were 26 in. in diameter, but it is now found that sheaves 18 or 20 in. across give satisfactory service. Provision is made for attaching a 14-in. sheave for use in cramped spaces. Other standards with orienting pulleys are required to carry the wire from the driving mechanism to the point where cutting is desired. For deep quarries a long wire may be needed. Wires from 800 to 1800 or 2000 ft. long are used.

The sinking of holes for the standards required a type of equipment entirely new to the slate district. Core drills making holes 36 in. in diameter are now in general use.



Tension post of a wire saw at one end of a cut in the Chapman Slate Quarries, Chapman Quarries, Penn.

Previous Reports Issued

The results of preliminary tests made in the Colonial Slate Co. quarry with the able assistance of Sidney Spry, president of the company, were given in a paper entitled "The Wire Saw in Slate Quarrying, Preliminary Report," Serial 2820, issued by the Bureau of Mines in July, 1927. The results obtained in practical use of the equipment by two other companies, (Chapman Slate Co. and Jackson Bangor Slate Co.), were described in a supplementary report, Serial 2851, dated January, 1928. Since the appearance of these two reports much progress has been made, and the present paper is designed to cover the results attained during the summer of 1928.

Equipment in Use October, 1928

The widespread popular acceptance of the wire saw and the phenomenal growth in its use are noteworthy. Late in 1927, when the second report was prepared, three companies each had one wire saw, and two core drills were in use. In October, 1928, the following equipment was noted in the Pennsylvania slate district:

WIRE SAW EQUIPMENT IN PENNSYLVANIA IN OCTOBER, 1928

Company	Wire saws	Core drills
Colonial Slate Co.	2	1
Imperial Slate Blackboard Co.	1	..
Phoenix Slate Co.	2	1
Keenan Structural Slate Co.	2	1
Stephens-Jackson Co.	2	1
North Bangor Slate Co.	1	..
Columbia Bangor Slate Co.	1	..
Jackson Bangor Slate Co.	3	1
Belmont Slate Co.	1	..
Bangor Fidelity Slate Co.	1	..
Parsons Bros. Slate Co.	2	1
Diamond Slate Co.	1	..
Doney Slate Co.	1	1
Slate Products Co.	1	1
Bangorvein Slate Co.	1	1
Chapman Slate Co.	2	1
American Slate Quarry	1	..
Albion Vein Slate Co.	2	1
Total	27	11

Thus the number of wire saws increased from 3 to 27 in about a year.

Sinking Standard Holes

The difficulty of sinking 36-in. holes for the standards was successfully overcome through the development by a machinery company of a rotary drill that has given excellent service. Steel shot is used as the abrasive. The cutting drum is 30 in. high, so that each 30-in. section of the core must be removed to make way for further cutting. A rate of 30 in. in 50 minutes' actual cutting time has been attained.

The process of removing a core section as employed by one of the companies first using the drill was as follows: The cutting drum was raised from the hole and set to one side. A jack-hammer hole was drilled 30 in. deep in the center of the core. About a pint of black blasting powder was poured into the hole, tamped with slate dust, and fired by fuse; the shock split the core free at the bottom. This was easily accomplished as the slaty cleavage dips 10 to 15 deg. from the horizontal. Another hole was then drilled a few inches deep, a little to one side of the first, and a spit key with an eye at the top was driven down. A wedge was placed in the split, and when

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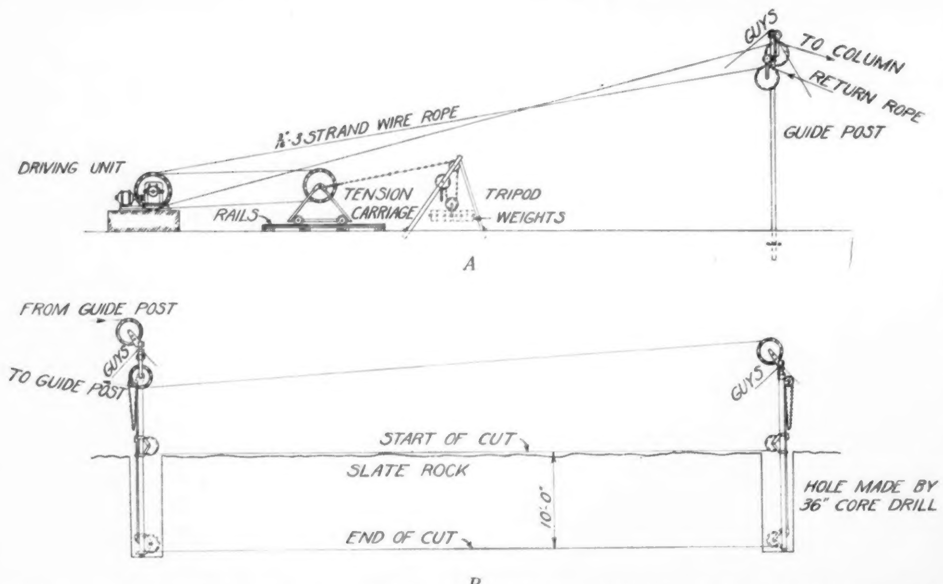
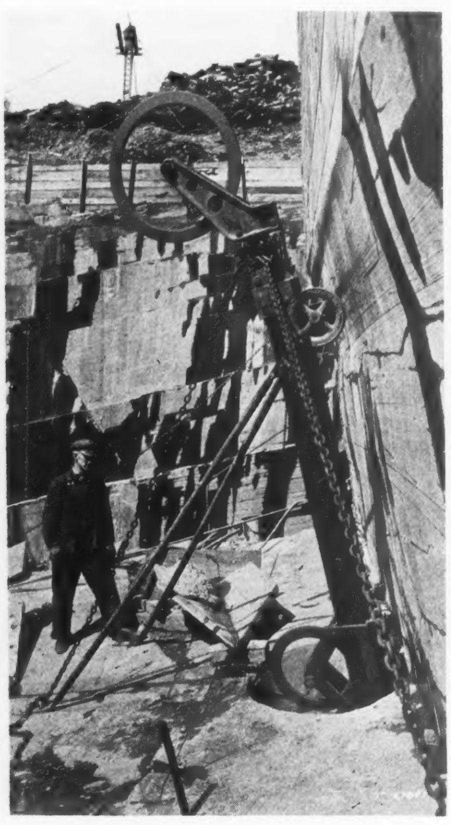


Fig. 1. Diagram of a wire saw, showing the driving end (A), and the cutting end (B)

it reached the bottom of the hole, further driving caused it to spread the key, and thus hold it securely in place. The block could then be hoisted out by placing the hook of the hoist cable in the eye of the split key.

Removing the Cores

In the late summer of 1928 an improved method of removing the cores was worked out. Before commencing work with the core drill a jack-hammer hole was drilled in the center of the mass to be removed to the full depth of the core drill hole, usually about 10 ft. When the first 30-in. core was drilled and the cutting drum removed, a wedge was driven into the cut. The force of the wedge split the core loose on the slaty cleavage, which is nearly horizontal in many of the quarries. At the same time it shifted the block a little to one side, and when the split key was driven into the hammer-drill hole previously made, the hole was sufficiently offset at the break for the wedge to encounter the upper surface of the unbroken core at one side of the hole; thus with further driving the wedge spread the split key and permitted the block to be removed with the hoist. The one hammer-drill hole served for all the cores, and the necessity for drilling each one separately was avoided. The wedging method is better than drilling and blasting, though the latter method may be necessary in rock that splits with difficulty.



A set-up in the Colonial Slate Co. quarry at Wind Gap, Penn., showing the tension post set in a 36-in. calyx core hole

The core-drill holes are commonly sunk in hard ends, or intersecting ribbons or seams, and thus the material in the cores is usually of inferior quality. Cores of good rock may, however, be used for roofing-slate manufacture.

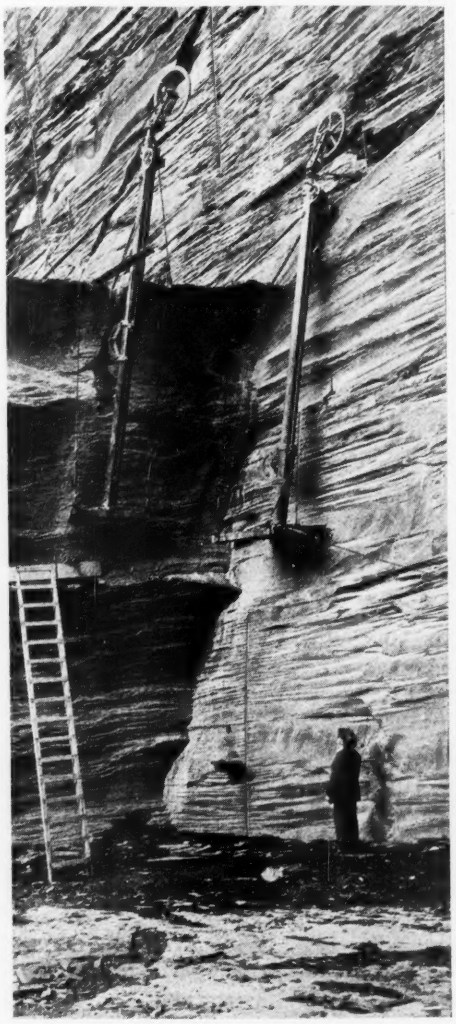
The first 10-ft. hole put down in one Pen Argyl quarry required four days' work, including time of set-up. The second hole required three days and the third two days. This indicates the time efficiency that may be attained through increased familiarity with the equipment. The sinking of a 10-ft. hole in one day or a little more is now not uncommon.

The holes may be made vertical or may be inclined at any angle up to 45 deg., though the cutting is slower in inclined holes. Very often the holes are inclined to follow the direction of the ribbon in order that the standards may be similarly inclined to make the cut parallel with the ribbon and thus avoid waste.

In one corner of their quarry Parsons Bros. Slate Co. sunk a hole at an angle of about 70 deg. to a depth of over 40 ft. This was an interesting accomplishment in that it indicates the feasibility of reasonably deep drilling with the core drill.

Channel Cut Substituted for Core-Drill Hole

A channeling-machine cut has been used in one quarry in the place of a core-drill hole. A short 6-in. channel cut is made parallel with the direction in which the wire is to run. The standard is set over it, and a piece of railroad rail clamped to the standard projects downward into the cut. The movable pulley frame slides on the rail and thus guides the downward course of the wire. Fairly satisfactory results have been obtained, but the equipment lacks rigidity when the wire operates under heavy tension.

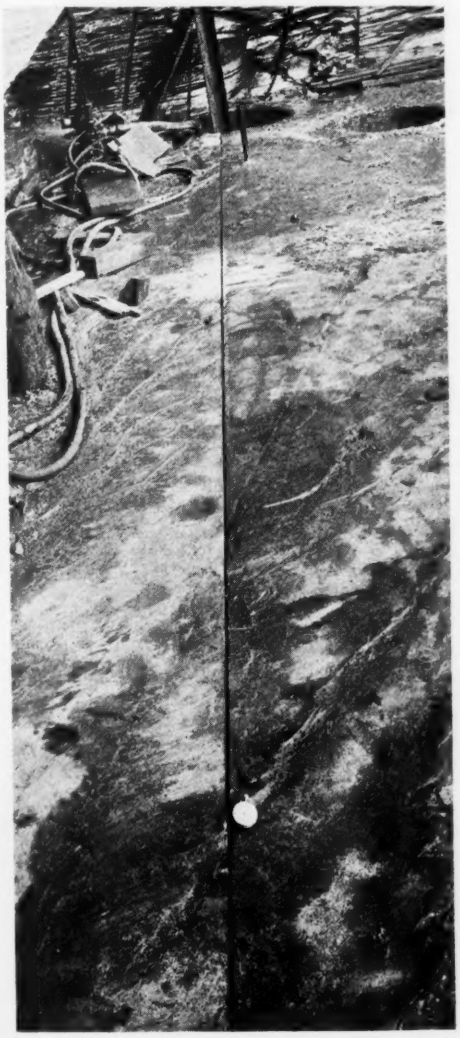


Suspended tension posts on a wire saw set-up in the Chapman quarries

Pinching of Wire

Some difficulty has been caused by the closing of the rock on the wire. The rock may be under compressive stress so that when the cut provides a means of relief, the rock expands and closes the cut. This is most likely to occur in a sink cut—that is, the original cut in a new floor—for when

a trench is once cut the pressure is relieved by expansion. Movement as a result of relief from compressive stress is usually gradual, and if the wire is kept constantly at work, no interruption may occur; if work is suspended during the night, however, it may be impossible to start the wire in the morning. On this account it is customary in several quarries to keep the wire running night and day until a cut is completed.



A wire saw cut at the Chapman quarries. Note the width of the cut compared to the watch

The movement of the rock may be abrupt and may stop the wire suddenly. The movement may not be caused by rock expansion but simply by the slipping of a rock mass. Open seams designated as "loose ribbons" may permit such movement.

The pinching of a wire almost invariably results in cessation of work in the particular cut involved, for a wire once caught by rock movement can rarely be started again. If the cut has already been carried downward several feet, the rock mass may be removed in the course of quarrying to the bottom of the cut, and thereafter a new cut be made to the desired depth. If a cut must be abandoned a short time after it is started, a new cut is begun a few inches to one side of the original.

Obviously, every precaution should be taken to prevent pinching of the wire. Some operators drill holes at intervals along the cut and drive plug and feather wedges in them. This will prevent a mass of rock from sliding against the wire.

Another preventive measure is to avoid, if possible, making a cut intersecting an open seam at a long angle, for V-shaped masses at the intersection of the wire cut and the seam are inclined to break loose and jam the wire. Wedging would probably fail to prevent such an occurrence.

Wire Construction

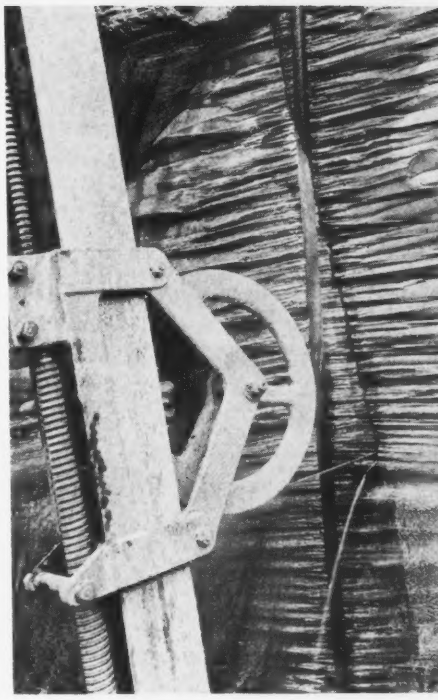
Several companies have stated that a closely twisted wire is preferable for cutting, as it holds and carries the sand more effectively and therefore cuts faster than wire wound at a long angle. Another objection to the wire wound with a long twist is the danger that the splices will pull out. As the wire operates under a heavy tension, the splices must be strong; closely twisted wire provides sufficient friction between the strands to withstand the tension.

Size of Wire

Two standard sizes of wire are in use, 3/16- and ¼-in. There is some difference of opinion as to which is the best. Some operators believe that if there is any probability that a wire will be worn out before a cut is finished, it is best to begin with a ¼-in. wire, as it would be easy to follow with a new 3/16-in. wire. According to others, this precaution is unnecessary, for even a greatly worn 3/16-in. wire makes a cut sufficiently larger than its diameter to permit the entrance of a new wire.

Inserting New Wire in Cut

Difficulty is commonly experienced in placing a new wire in a partly completed cut. When introducing it from the top of



The lower sheave at the bottom of a wire saw cut

the cut, the irregularities of the surface will cause it to bind unless the wire is oriented in a position exactly parallel with the direction of the wire when the cut was made. It is almost impossible to maintain this parallelism, and therefore it is better to splice the new wire to the old and draw it through the cut.

Operating Suggestions

In operating a wire saw, the wire should not be forced down too rapidly. Some operators use a steel gage to measure the depth of the cut near the center, and the downward movement of the guide pulleys is governed by the rate of progress at the center.

It is highly important that the center be

Lower sheave wheel at the bottom of a cut in a quarry 350 ft. deep. Wire saw in operation at the Jackson Bangor Quarry, Pen Argyl, Penn.

cut down to approximately the same level as the ends. This may require that the wire be kept running for some hours after the ends of the cut are finished. For very long cuts it is customary in some quarries to put down center holes in which center standards are placed midway between the end standards. The center standards are provided with movable sheaves actuated by worm gears similar to those of the end standards so that the wire may be forced downward at the center as well as at the ends.

The grade of sand best suited for wire-saw work has not yet been definitely determined. The sand, however, should be free from pebbles, and of such a size that the grains will carry well and provide effective cutting surfaces. A crushed quartz running 100% through 20-mesh and 95% on 70-mesh is now widely used. At present study is being made of the quality and grain size of sand that will give the most effective service.

Lost Time in Winding Back the Worm Gear

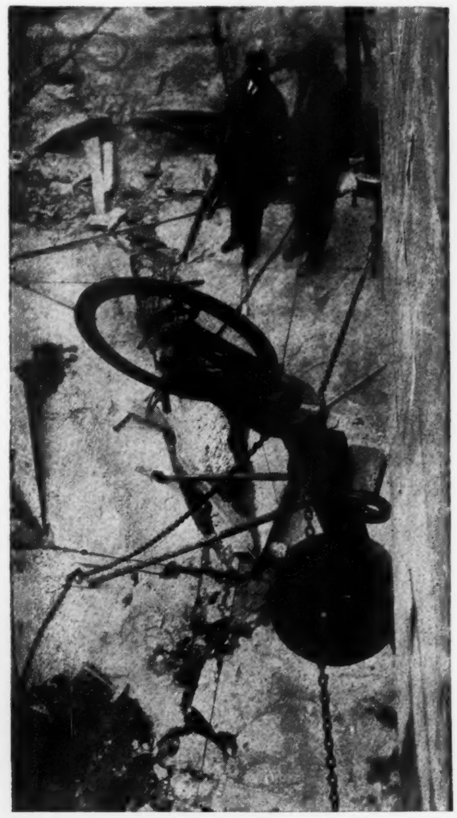
When a cut is completed the lower guide pulley is usually at the bottom of the standard, but before starting a new cut it must be elevated to a point near the top of the standard. This procedure involves winding back the slow-motion worm gear and requires much time and labor. An improvement has been developed in the construction of the standards whereby the gear shaft is made to project so that an air-driven mechanical rotator may be attached to its square end. This permits rapid winding, and the use of compressed air saves a great deal of hard manual labor.

Wire Saw Compared with Channeling Machine

Careful records of results accomplished with channeling machines in a large slate quarry at Pen Argyl, Penn., showed that the total square feet cut by four channeling machines over a period of five months was 13,729 sq. ft.; reduced to a basis of actual working time as shown on the men's time cards, this indicated an average of 31 sq. ft. per day for each machine.

Two slate companies kept detailed records of work accomplished with the wire saw, and their reports are summarized as follows: Two wire saws were used in one quarry, and a record was kept for 20 days, during which time three men were constantly employed either in operating or in setting up equipment; during the period seven cuts were made and one core hole 14 ft. deep was drilled; the total surface area cut was 6060 sq. ft., an average of 303 sq. ft. per day for the two saws, or 151.5 sq. ft. per day for each saw.

Another company kept a record for 14



Tension post set up in a 36-in. calyx core drill hole, with the wire saw starting the cut

wire-saw cuts, totaling 9650 sq. ft. The running time exclusive of setting up, but including all stops and delays from various causes incident to the work, was 623.5 hours. During this period one man was employed continually. An additional man was employed in setting up the equipment for each cut. This required 70 hours' additional time. The total time reduced to a 9-hour day basis would be 77 days, and the average cutting rate would be 125.3 sq. ft. per day.

The above figures indicate that in a given period of time the wire saw will cut four to five times as much as a channeling machine.

One company that formerly used seven channeling machines has placed all the machines on the quarry bank, and three wire saws have been substituted for them. In October, 1928, the quarries were in unusually good condition, for so many cuts had been made that very little further cutting was needed to provide rock for the winter months. It is stated that when channeling machines were used, it was never possible to have cutting completed so far ahead of block removal.

In the Chapman slate quarry, showing where a wedge of slate has been removed by wire saw cutting. The tension posts are set up in the 36-in. core drill hole

Wire saw in operation at the Colonial slate quarry. Note the triangular-shaped box for feeding sand and water to the saw in the cut

Manufacturers of Wire-Saw Equipment

The following companies manufacture standards, tension cars and other related equipment: the Stroudsburg Engine Works, Stroudsburg, Penn.; the Pen Argyl Manufacturing Co., Pen Argyl, Penn.; orders for motor drives and other wire-saw equipment are taken by the Quarry Supply Co., Pen Argyl, Penn.; the Ingersoll-Rand Co., 11 Broadway, New York, N. Y., manufactures the core drill.

Use of the Wire Saw in Slate Mills

The unqualified success of the wire saw in slate quarries suggests an extension of its use in slate-finishing mills. In mills where circular saws are now employed the blocks might be lined up in such a way that many of them could be cut at one time with a wire. Such a process is not new. The wire saw has been used for many years at marble yards. Ten to 20 blocks are lined up and a wire is used to "scabble" or square them up by slabbing off the irregular surfaces. The equipment would be much simpler and less expensive than circular saws. The designing of such a mill has not yet been undertaken, but it offers a fruitful field for enterprising operators.

A Study of Mineral Fillers

IS THE STABILITY of bituminous paving mixtures due to decreasing the voids in the aggregate or are there other factors that must be taken into account? This is the question that Yasuhei Emori endeavors to answer in his paper, "Mineral Fillers in Sheet Asphalt Paving Mixtures," presented as a thesis for the degree of Civil Engineer at the University of Michigan.*

As the function of fillers is to decrease voids, thereby increasing the density and water tightness, not only void tests but stability tests and absorption tests were made on specimens which contained the following fillers: Limestone dust (ordinary commercial filler); finely ground limestone dust; coarse limestone dust; silica dust, a by-product of plate glass making; portland cement. Natural clay, celite and tripoli were used in a few special tests.

All these were used with sand which had been separated into sizes and combined to correspond to Richardson's ideal heavy traffic grading. The filler content was varied according to the test that was made. In the voids and stability tests the amount of filler added was such that the minus 200-mesh was constant, the percentages varying between 12.4% and 15.4%. Void determinations on the dry aggregate were made by the cone method. This is done by putting the aggregate into a cone in small quantities at a time, oscillating the cone all the while to cause it to compact. From 300 to 500 oscillations were needed to thoroughly compact it. The determination of the fineness below 200-mesh in the filler was made by sedimenting and decanting, following a standard method of soil analysis of the U. S. Bureau of Public Roads.

The paper is long and detailed and liberally illustrated with charts. The first of these shows that there is a considerable difference in the reduction of voids obtained by adding different fillers. On the dry aggregate the ground limestone reduced the voids the most, with slaked lime as a close second. The voids in the compressed specimens of paving mixtures corresponding followed the voids in the dry aggregate closely. In the stability tests, however, the slaked lime filler gave the best result, with limestone dust second. In mixtures having equal *volumes* of filler, portland cement was second, but the silica dust was fourth in all cases. It is noted, however, that silica dust has the advantage of greater workability.

Mr. Emori concludes from these experiments that while stability is related to the voids in the aggregate, the relation is neither direct nor very close. He therefore made a series of tests to bring out the other characteristics of the fillers than fineness. The important facts developed were that the silica particles were more angular and that they had less power to absorb the asphalt than the calcareous materials.

From all the tests he concludes that all calcareous fillers fill voids and increase stability better than silicious materials. Using the same kind of filler, he finds that stability is directly related to voids, but he finds no constant and uniform relation between voids in the aggregate and stability where different mineral fillers are compared. The finely ground filler was best, the most effective void-filling particles being those of less than 0.05-in. diameter. The affinity which exists between asphalt and calcareous materials he concludes is instrumental in reducing the voids in the mixture and contributing to stability. In tests for water tightness the filler most effective in reducing voids in the mixture also rendered the mixture more water tight.

**Proceedings* of Fourteenth Annual Conference on Highway Engineering, University of Michigan, 1928.

Effect of Flat Particles in Gravel

THE PRELIMINARY INVESTIGATION by the laboratory of the National Sand and Gravel Association of the effect of flat particles on the concrete-making properties of gravel, which was carried out through the cooperation of a member company, has been completed. About two tons of gravel separated into round and flat particles were secured and compression and transverse tests of concrete made using gravel from which the flats had been removed, and also with gravel containing 10% of flats in one case and 14% in another. The results of tests on a 1-2-3½ mix, using gravel graded from ¼- to 2¾-in., and on a 1-2-2½ mix made with gravel graded from ¼- to ¾-in., showed the flat particles to have no effect on either the compressive or transverse strength up to 28 days. A detailed report of these tests will be available for distribution in the near future.—*National Sand and Gravel Bulletin.*

New York Slate Quarries Closed for Two-Month Period

ALL sea-green slate quarries in the Granville, N. Y., section belonging to the slate pool have closed down for an indefinite period. These include the quarries of the H. G. Williams Slate Co., Sheldon Slate Co., Owens Bros. Slate Co. and Norton Bros., all of Granville; Rising and Nelson of West Pawlet, Auld and Congor of Poultney and Williams Bros. Slate Co. of Middle Granville. The South Poultney quarry of the Sheldon Slate Co. has been closed for several weeks. Many of the other quarries have been operating on a four day a week schedule for some time past.

However, the John D. Emack slate yard, one Vendor slate yard, the Elbel quarry and the B. Jones quarry, all located in the Middle Granville district, will continue to operate on full time. Future business looks increasingly bright, according to John S. Jones, slate broker.

It is estimated that the shutdown will last two months, and the cause is given as being due to large stocks of slate being on hand for which there is no immediate market. It is stated that the high-grade of slate produced in the Mettowee valley cannot compete in price with the less expensive slate produced in Pennsylvania and with foreign slate.—*Albany* (N. Y.) *Press.*

German Lime Engineer's Visit to American Lime Plants

Ourselves as Others See Us

LAST YEAR the German engineer, Horst Laeger, visited a number of American lime plants and his impressions and criticisms are being published in a series of articles in *Tonindustrie-Zeitung*, some excerpts and review of which will be of interest. His series starts: "Trip to America—the allurement which there is for many in these words, again and again causes us to feel the desire to travel there in person and so see that land which according to myth is the land of unlimited opportunities. The old aim of German longing, Italy, fades in our age of engineering, compared to the force with which that giant on the other side of the world sea draws us under its ban. Our heartbeats stop perhaps a moment when we think how our new giant ships furrow through the ocean and will, upon the world sea, again bring our flag to its old glory just as the Zeppelins in the air—as new links between America and ourselves."

United States a Country of Contrasts

He continues, "One must not draw general conclusions of the structure of American management from the impressions of the large plants, which are viewed as a rule more or less hastily. Speaking of labor, mass production, supply and demand, savings, etc., he states, "What I point out here shows the inequality of American conditions. In fact, America is, perhaps due to its youth in the history of the world, the land of great contrasts."

On his trip he benefited from the suggestions made by Mr. Arthur (then general manager of the National Lime Association) "in amiable manner" and continues: "Everywhere on my trip I was received pleasantly and often cordially." In presenting the data and statistics on the American lime industry, he states that the 75 plants of the National Lime Association produce 80%, whereas the members of the lime association in Germany produce 95% of the total production. About 50% to 55% of the total American lime production is building lime, in Germany only 37% to 40%; about 40% to 43% of the total production is chemical lime, and in Germany the percentage is slightly greater. In reference to the presentation of American statistics on slaked or hydrated lime and finishing lime he states: "Unfortunately the corresponding figures for Germany are lacking, since such statistics are not carried by us. The model public-spiritedness of the Americans, however, supports all endeavors of this kind emphatically; there is no mysterious conduct of any kind. To be sure, abundant means are perhaps also available."

Mr. Laeger then continues: "From Washington I traveled by the 'Red Arrow' express, which travels on the average slower than our express train, and instead of smoothly with a three-fold exhibition of noise, to Toledo on Lake Erie, and arrived thus in the heart of Ohio, the largest lime center of the world." [He must have read some of the publicity material originating in this locality.—Editor.] Speaking of the finishing and mason's lime as having a fineness of 2% to 3% on the 100-mesh screen, "this fineness is not especially fine compared with our requirements."

Dipl. Ing. Horst Laeger

Some Rather Erroneous Conclusions!

In reference to the construction of lime plants he states that "nearly every plant in the States co-operates with an independent consulting engineer. [As a matter of fact, very few employ consulting engineers—more's the pity!—Editor.] Whereas our civil engineers represent for the most part certain firms, the consulting engineers over there are entirely independent and obliged to consult their customers without any one-sided obligation." He states that "over there the combination of lime and cement production within a company and especially in a plant is far more rare than in Germany, so that the lime industry is frequently supplied from special offices . . . which buy only equipment for lime plants from the various firms and supply it, whereas with us the supply of automatic kilns, mills and individual machines comes direct from the machine factories which as a rule supply also cement plants. Also the design of the plant in respect to the buildings is left frequently to the machine factories which must supply the drawings for the entire plant." He finds competition keener among the German machine manufacturers and they must often make large sacrifices in respect to constant improvements and new inventions.

Greater Economy of German Lime Burning

Referring to Victor Azbe's visit to the lime plants in the Rhineland, and his findings of rather considerable superiorities over similar American plants, Mr. Laeger states: "I believe that one operates in such German plants more economically with lesser means. And yet one can be thankful that he sees in a highly developed country entirely different views, which in many things very much stimulate him to reflection. Rightly so, it has of late been emphasized from various sides that we (Germans) stand still behind America in the psychologically correct handling of men in economic or industrial life. This ascertainment is perhaps more important than all exterior appearances which are reported to us from America. The conception of 'co-worker' enters over there in the place of the reciprocal distrust in which employes and employers here stand often opposed to each other. Over there it assumed as a matter of course that he who 'makes' more dollars plays a bigger role; and yet, it counts for much when the owner or manager of a plant speaks to a common laborer a few times daily his 'Hello, Charles'."

In describing the new plant of the Gibsonburg Lime Products Co., Gibsonburg, Ohio, Mr. Laeger states that "though the output is rather low and the fuel consumption high, one is astonished on the other hand concerning the amount of steel that is built into this kiln house for 90 tons total daily capacity. The shape of the kiln is more difficult to line than our shaft kilns, and as a result the refractory brick last frequently only six months. The lime is drawn very hot, according to our notion. . . . The kiln

'hangs' frequently, special bars for stoking lay ready everywhere and are used also for drawing. There prevails such a dense smoke at the top that frequently one cannot tarry there for an extended period. The starting of the drawing operation is evidenced by much whistling between the upper and the lower firing floors, and in this manner makes itself noticeable for quite a distance. . . . A bucket conveyor raises the crushed burned lime into a bin holding 550 tons, under which Raymond discharge apparatus is provided. This discharge arrangement is very good and is used similarly in Germany, especially with fine, easily passing material. . . . Grinding and bagging [the lime after being hydrated—Editor] is done on demand, when a car is ready; therefore fresh lime is always available, a requirement which is made over there by many consumers. Therefore there is no storage provided at all for bagged lime." In describing the Raymond impact mill, he continues: "The blower, which consumes about 40 hp., then forces the fine flour and air mixture into the cyclone for separation. Because of it this kind of conveying differs from the method customary in the new Loesch mill in which the fine flour and air mixture is aspirated into the cyclone and thus a considerable protection of the blower blades which come in contact only with nearly pure air is provided." In describing the Bates packer, of 400 bags per hour capacity, he states that a machine set up in Germany packs 750 bags per hour.

Substantial Construction in America

And he continues: "What impression does such an entirely modern plant make? First of all one is astonished concerning the quantity of steel built into this plant. To place 450 tons of steel, or 45 carloads, upon a ground area of a little over 1000 sq. m., is in itself a feat. In relation to the very complicated design, the output of 90 tons of lime per day is, according to our notion, concededly small. But the arrangement of the plant, the consideration for future extension and the easy visibility is worth patterning. The finishing of the exterior is also very good; on the outside and inside 4150 sq. m. of corrugated sheet metal roof and walls are provided with a protective coat which consists of three layers. Asphalt, asbestos felt and a waterproof surface coat protects against rust and destruction by waste gases. This plant, which cost about $300,000, is not insured against fire, since nothing can burn. This certainly great advantage, however, will not, according to our notion, return the interest for the high construction costs. Involuntarily the question arises, whether these installations, which were erected in favorable times, will still operate profitably under a reduction in price easily possible over there, and by a letting up in the demand."

In describing the new plant of John Herzog and Son in Forest, Ohio, he states: "Noteworthy in this plant is the coal delivery to the kiln house. . . . Coal bins are installed ahead of the furnaces, the design of which is not practical because with damp coal it gives cause for clogging." Continuing discussion of the lime kilns, Mr. Laeger writes that "differences compared to plants familiar to us exist first of all in the insertion of a lime bin required for the cooling off of the very hot-drawn lime, furthermore in the selection of the slaking equipment, which consists here (in Germany) of spirals for wetting and of bins for steaming, over there of 'hydrators' (slaking in periodic or continuous operation without storage in a bin). I will return to the old question 'Which is better?' after discussion of the most important hydrators. Now it will be said that over there, with various exceptions, it concerns lime which is hand-picked after leaving the kiln, and always a product which is chemically very uniform!"

Describing the Woodville Lime Products Co. plant at Woodville, Ohio, he asserts that "one can see in the photograph accompanying the thick dense smoke which here—as in most cases—comes from the kiln plant, but appears to bother nobody. Shortly before I had seen on a trip through Poland kilns which also filled the neighborhood with hideous smoke. To be sure, these were aged and venerable witnesses of a number of decades. At these Polish plants for driving the hoist was a horse, which knew its to and fro movement by heart down to each single step. In the case of the modern American plant the hoist and the exterior is equipped with all acquisitions—but of what use is all this when the coal consumption is exactly as great and the output is exactly as at the Polish plant?

Comment on Kelley Island Plants

The collecting system for the wastes from the impact mills and baggers in the Gibsonburg plant of the Kelley Island Lime and Transport Co. is considered very practical, as it saves sweeping and dust and requires only five minutes of operation daily. In describing the White Rock plant of this company, Mr. Laeger writes: "There are not less than 63 shaft kilns and one rotary kiln. . . . The rotary kiln is fed with material of 20 to 35 mm. size. The material must therefore be crushed and picked so that considerable expense comes through the waste. At another place we will see that the operator of a plant with two large rotary kilns is thinking seriously, due to the impression of this uneconomical operating method, about the erection of new serviceable shaft kilns.

"It may be recalled here that according to my knowledge the first and only attempt made in Germany (Ruedersdorf) a number of years ago, to burn lime in a 60-m. (197-ft.) rotary kiln was given up due to its wastefulness. It was difficult to burn pieces of greater than 25-mm. size completely and safely. Also the coal consumption of the rotary kiln, 36.2% of the burned lime, using a coal of 7500 kcal. (13,500 B.t.u.) is very high; since more than 270,000 kcal. (1,080,000 B.t.u.) are required for 100 kg. (220 lb.) of burned lime. These figures appear almost unbelievable to us; but one must always bear in mind that even good coal over there is comparatively low priced and frequently costs only one-half, yea, one-third of the sales price of the burned lime. The stimulus to save in this respect is therefore slight."

A detailed description of the design and operating results of the Wood gas producer, Type SB 10, is given, which "undoubtedly . . . presents a well thought through and dependably operating machine, which has overcome entirely many shortcomings of the old, expensive, inconvenient predecessors." Then the author continues: "A million city developing itself in strides is Chicago. Favored by the geographical location in the middle west as through point and outgoing point of many railways and outstandingly suited as the turnover point for inland navigation due to its direct location on Lake Michigan, this city will perhaps outstrip New York sooner or later. The very important Marblehead Lime Co. recognized early the favorable prospects which a lime plant located near Chicago would be bound to have under the rapid development of this city so important as a financial and industrial center." Mr. Laeger comments favorably on the care given in the various plants of this company in picking the cooled lime, the control of the plant, the making of improvements in the equipment mostly as a result of experiments made in the plant, regular analysis of the raw materials to assure uniformity of product, etc.

After describing his visit to the Chicago plant of the Marblehead Lime Co. Mr. Laeger writes: "Mr. Rockwood and Mr. Sullivan of the publishing house of Rock Products, Chicago, which in importance is equal to the *Tonindustrie-Zeitung*, accompanied me, always ready for assistance, also to the great quarrying plant of the Dolese and Shepard Co. south of Chicago." In describing the Woodford electric haulage system used here, he continues: "One cannot withdraw himself from the mighty impression which this plant operating like a plaything makes probably upon every visitor. Two men overlook the wide quarry from an elevated switch house and cut in the motors of the cars upon signals from the steam shovels. It is moreover—conformable to the well-known step from the sublime—really a delight to the gods to see these men work in stoical quietness. Their trousers band, as customary, secured or not secured by a belt, at the lowest stage of possibility, after every fifth switch adjustment the otherwise unmovable heads turn a little to the side and spit into a half-filled bucket! Something like this must appear the picture of the soul blunted by the machine! But nevertheless—one is independent of high-priced working power or labor. — *Tonindustrie-Zeitung* (1928) **52,** Nos. 101, 103; (1929) **53,** Nos. 1, 5, 10, 13, 15.

Hints and Helps for Superintendents

Finding the Diameter of a Circle When the Arc Is Known

CHARLES LABBE
Death Valley Junction, Calif.

THE usual method of finding the diameter of a circle when an arc is given is to use the following formula: The square of half of the chord, *AB*, plus the square of the distance from the circumference to the chord, divided by this last distance, *CD*, gives the diameter of the circle.

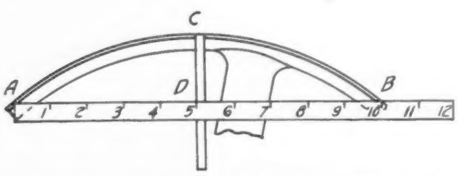


Diagram showing a simple method of finding the diameter of a circle

But still simpler is the following method that I will explain: If at the start the line *CD* is made 1 (that is, 1 in., 1 ft. or 1 mile) the formula is simplified as follows: The square of *AD* plus 1 equals the diameter of the circle.

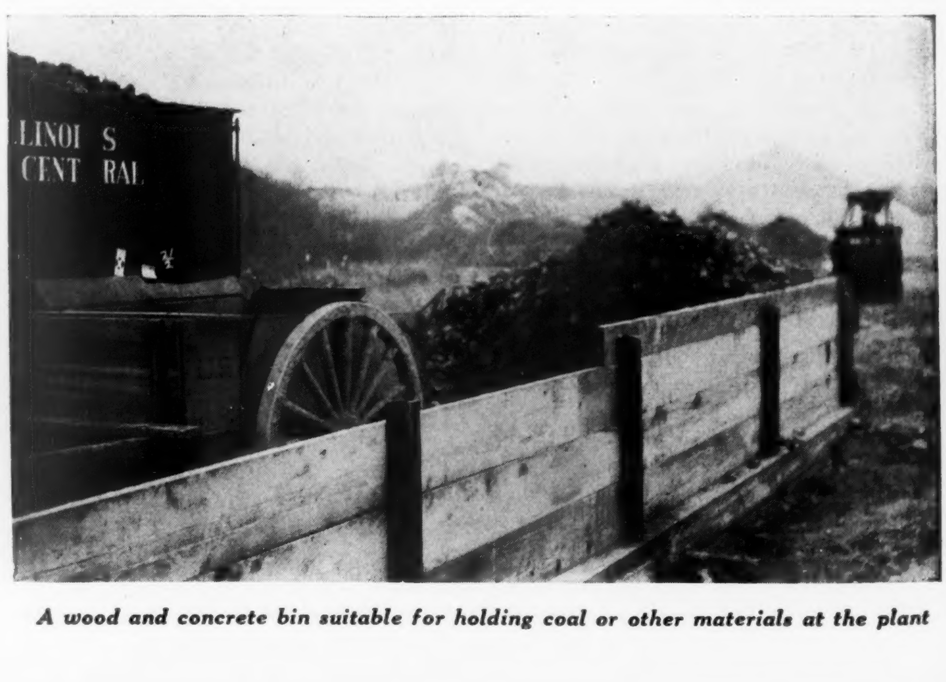
In the drawing, the arc *ACB* represents the broken piece of a pulley. Place a graduated scale across the edge 1 in. distant from the edge at the widest point. The scale shows the chord thus produced to be 10 in., so we have half of 10 is 5, $5x5 = 25$, and adding 1 it is 26. Hence, 26 in. is the original diameter of the pulley. Measured at any other place than 1 in. from the circle makes the figuring harder.

Substantial Bins Made of Concrete, Planks and Railroad Rails

A THOROUGHLY substantial and inexpensive bin can be constructed similar to the one shown in the illustration. This bin has a concrete floor and a few inches of its sides are also of concrete. In these low side walls vertical pieces of lightweight railroad rails were set during the pouring of the concrete. To these vertical rails 2-in. planking is fastened, thus forming the sides of the bins. For drainage, a 2-in. pipe was inserted through one of the side walls during pouring, and as the floor was sloped to carry water to this pipe, standing water in the bin is eliminated. The pipe shows at the bottom of the picture.

The bin pictured was constructed at the Wilmot, Wis., plant of the American Sand and Gravel Co. It is used for coal at that plant, providing a clean and dry receiving bin for fuel for the pit dinkey and shovel. The concrete floor makes reclaiming an easy matter for this bin.

Also note in the illustration the use of an old United States army munition cart for the transportation of the coal about the plant. The use of this two-wheeled, horse-drawn cart has proved very satisfactory at this plant.

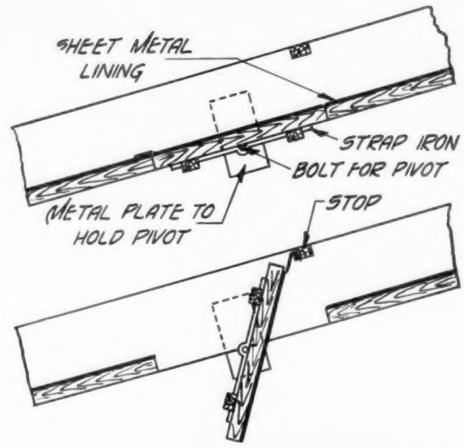


A wood and concrete bin suitable for holding coal or other materials at the plant

Swinging Gate for Chute to Deflect Material from One Bin to Another

SLIDING and swinging gates have been used more or less commonly in stone and gravel plants for the deflecting of material in the chutes from one bin to another. The accompanying drawing shows a type of swinging gate which is not in common use, and yet is very satisfactory because of its simplicity and durability. It is, moreover, easily constructed with materials and tools generally found around the average plant.

The drawings show a gate in a chute lined with a sheet metal. This particular chute was about a foot wide, though a variation from this width does not affect the method of construction. A space about 2 ft. long is cut from the bottom of the chute. The piece removed is then pivoted in place so that it can assume either of the positions shown in the drawing. The pivot is constructed by fastening metal plates to the outside of the chute on either side, boring a hole in each plate and passing a ½-in. bolt across the chute through the two holes. The gate is fastened to this bolt by means of two pieces of strap iron, shaped to pass over the bolt and be screwed securely to the wood of the gate. Wood cross pieces can be added to the gate, as shown, to strengthen it if it is thought necessary.



Cross sections of a swinging gate in a chute showing it in closed and open positions

The metal sheeting on the gate itself is extended 3 or 4 in. beyond the lower end of the gate so that when the gate is in its

normal closed position there is a tight joint there. This extended metal also serves as a stop, holding the gate in its correct place when in normal position. When in the open position, the gate is held in place by a wood or metal stop as indicated. The weight of the gate itself prevents it from being changed in position by falling material or other accidental means.

By this gate, material can be sent directly to a far bin or dropped immediately to a nearer bin beneath the chute. Combinations of various size stone can be secured in different bins, and also one chute can be made to serve two or more bins by its use. The gate described above was noted at the plant of the Lima Stone Co., Lima, Ohio.

Belt Feeders for Reclaiming Tunnels

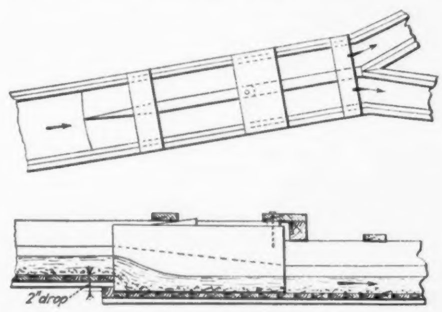
In most cases where a storage pile or bin full of crushed rock products is reclaimed by belts running in tunnels under the stockpiles, the material is fed to the belt by simply opening the gate a certain amount, allowing the rock to spill directly on to the belt. However, there are certain materials, such as crushed gypsum and some crushed stones, that will not "run," and some method must be devised for feeding to the reclaiming belt.

Usually this consists of various types of reciprocating pan feeder gates or quadrant cut-off gates actuated by wire cables through a cam or crankshaft, with suitable counterweights for the reversing mechanism. This type of feeder is a constant source of trouble, due to the necessity for clamps between each gate, cable slipping, misalignment between succeeding gates and the cable, whipping of the cable and the short cable life.

At the Security plant of the North American Cement Corp., crushed limestone for cement manufacturing purposes or for commercial stone is reclaimed by a belt conveyor fed by quadrant cut-off gates, each gate being repeatedly opened and closed by an arm bolted to a reciprocating longitudinal steel bar paralleling the entire length of the conveyor belt. The main bar is ¾x4-in. and is made up of a series of short bars bolted together. One or more gates can be fastened to this bar by simply bolting the connecting arm to the reciprocating bar, even while the latter is in motion if necessary.

Launder Splitters

Launder streams are best split by a knife splitter as the stream is projected into a drop box, or, still better, by a weir of proportional length. This involves a loss



A launder splitter which properly divides the stream even after considerable wear

in head, however, which is not always permissible. Moreover, simpler devices lend a strong appeal. The one usually attempted is a tongue pointed upstream and hinged at its base. The lower edge of the tongue is supposed to hug the launder bottom, which is something it can approximate only for a short time until the sand, rolling on the bottom, wears an opening under the lower front edge. Thus, although the splitter may seem to be properly dividing the stream, actually it is not, for the reason given. This is particularly true when the splitter is making a fractional split, other than one-half. To obviate this difficulty it is suggested that the bottom of the launder be dropped an inch or so, as shown in the illustration. Wear will take place, but it will be on the front edge where the stream strikes and not on the lower point.—C. W. Tandy, in *Engineering and Mining Journal.*

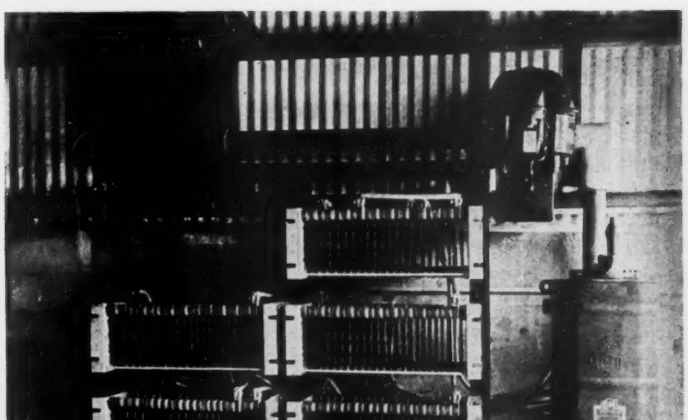
Starting a Flooded Crusher

An inopportune power failure, a broken belt or other items which cause a shutdown of a crusher, more especially a primary crusher, just at the time a load has been dumped into it, will often flood it and the removal of the rock by hand has to be resorted to.

At the plant of the Consolidated Quarries Corp., near Lithonia, Ga., they have overcome the trouble incidental to starting a flooded crusher by installing a reversible switch or controller so that it is possible to reverse the direction of the motor and the crusher. In case the crusher stops with a load on, it is only necessary to "rock" the crusher jaw until sufficient momentum has been obtained to relieve the jamming in the throat at which time the full power load can be applied to the crusher motor.

This method of starting a flooded crusher was the result of the unintentional installation of a reversible switch at a crusher and its value as a means of starting under load was discovered by the operator. Since then all the crushers have been connected to switches of this type.

Showing reciprocating bar for automatically operating cut-off gates in a reclaiming tunnel



The reversible switch installation which permits "rocking" the crusher to get it started when it is flooded with material

Recommend Tariffs in Rock Products Field

THE REPORT OF THE SUBCOMMITTEE of the United States house of representatives' committee on ways and means, in charge of tariff schedule No. 2, earths, earthenware and glassware, in so far as it relates to rock products, is as follows:

"Your committee has recommended rates in accordance with the hearings, the tariff information surveys and details presented by experts from the United States tariff commission. The rates in the existing law are maintained except where a new rate is needed to equalize competitive costs of domestic and foreign production. Changes in phraseology are made in several paragraphs, in order to clear the intent of the congress with respect to the classification of commodities which have been the subject of litigation. Consideration was also given to the protection of new industries developed since the enactment of the tariff of 1922. Three commodities have been transferred from the free list to a dutiable status under Schedule 2, namely, brick not specially provided for, which includes common building brick, portland and other hydraulic cement and crude feldspar.

"Brick not specially provided for is transferred from the free list (par. 1536) and a duty of $1.25 per thousand is imposed, under paragraph 201, due to the comparatively large importations of common building brick at New York City. Ninety-five per cent or more of the common building brick is imported free of duty. Practically all of the duty-free brick entered through the port of New York City competes with the Hudson river district.

"The wall and floor tile industry of the United States has had rapid growth due to the enormous building program of recent years. The quantity produced in 1927 was smaller than that of 1926, and imports have steadily increased since 1924. The selling prices at New York City of various types of domestic wall and floor tile, as compared with the costs to the importer of foreign tile, indicate the importer has an advantage. The rates of duty imposed under the act of 1922 are insufficient to protect the industry against the increasing foreign competition. The rates have been slightly increased in the interests of the American producer.

"In recent years 90% or more of the total imports of Roman, portland and other hydraulic cement entered free. From 1926 to 1927 over 74% was imported from Belgium, which country has the lowest costs of production of any European country exporting cement to the United States. Eighty-eight per cent of the imports in 1928 entered at the following ports: Boston, Mass.; Philadelphia, Penn.; Wilmington, N. C.; Charleston, S. C.; Houston, Texas; Portland, Ore.; Seattle, Wash., and Porto Rico. Practically all imported cement is sold in seaboard markets, where it competes only with the mills which ordinarily supply such markets.

"The domestic producers and the United States tariff commission have shown that the differences in cost of production in mills adjacent to the seaboard and that of Belgium cement (including transportation on both the domestic and foreign products to seaboard points in the United States) range from 38 cents to $1.16 per barrel, depending upon the point at which comparisons were made.

"The total shipments of domestic cement to seaboard markets amounted approximately to 25,000,000 bbl.; the imports to 2,285,000 bbl. A duty is imposed of 8 cents per 100 lb., including the weight of the container, which is equal to 30.4 cents per barrel.

Material for Cement Included Under Bill

"Paragraph 205: The materials from which Roman, portland and other hydraulic cements are made are burned together in a kiln. This burned or sintered material is known as cement clinker. It is subsequently ground with or without the addition of definite proportions of gypsum to form the cement of commerce. It is intended that the clinker shall pay the same rate of duty as the cement."

Proposed increases on glass and glass containers of various kinds will be helpful to American silica sand producers, if accepted.

Marianna Lime Products Co. Expanding Its Florida Property

THE Marianna Lime Products Co. of Marianna, Fla., is now at work constructing a large lime rock plant at Cottondale. The company has recently purchased considerable land in the section about the plant, including 1020 acres from M. L. Dekle, 1040 acres south of Cottondale from A. C. Thomas, 720 acres from James Barnes and 202 acres from M. A. and M. L. Speight. The acquired property touches the city limits of Cottondale, and is reported to contain excellent deposits.

The company is building its own rail connection to the main track of the Atlanta and St. Andrews Bay Line, a distance of about a mile, using 57 and 60 lb. rail. Property has been secured along the main line of the railroad for the erection of warehouses and storage quarters, and for manufacturing the products of the company. The company plans to install a large hydrating plant at that location for the production of commercial lime, and it will also manufacture clay brick there from deposits on the property.

Adam M. Lewis, president of the company, stated that the reason that such a considerable area of land was obtained was to provide for future expansion. He stated that the lands not utilized at once for the company's business would be used for the raising of pure-bred cattle, and added that in the purchase from A. C. Thomas, mentioned above, was included 100 head of fine cattle and hogs.

Mr. Lewis also said that the company's plans embrace the manufacture on a large scale of asphalt filler and commercial fertilizer. In the near future a laboratory and testing plant will be established, he stated.

Beside Mr. Lewis, the officers are John F. Lowden, acting vice-president, and D. A. Moyland, secretary and treasurer. Mr. Lowden was formerly auditor of the Industrial Loan and Guaranty Co., a holding organization for one of the largest systems of industrial banks in the country. The Industrial Loan and Guaranty Co. is one of the largest stockholders in the Marianna company.

Besides its Marianna and Cottondale plants, the company also controls a large plant at White Cliffs, Ark. It is also the owner of the Florala Lime Products Co., at Florala, Ala., on the direct line of the Central of Georgia railroad.

As a further step in the company's development, a 20-story office building is planned in Chicago to be the northern home of the company. This building will be at the corner of Lake and Wells streets and will cost $3,000,000.—*Marianna* (Fla.) *Floridan.*

Western Pennsylvania Sand and Gravel Producers Organize

THE Western Pennsylvania Sand and Gravel Association has been organized among the producers of the western part of the Keystone state for the purpose of trade promotions and for the improvement of the service and welfare of the sand and gravel industry. The members who applied for the charter and who are designated as directors for the first year are Harry S. Davison, Philander K. Rodgers, H. Clay Rodgers and George Vang, all of Pittsburgh; W. Agnew Bliss, Beaver; Alexander W. Dann, Glen Osborne and C. C. Patterson, Mt. Lebanon.

The association has announced the appointment of Ray Warren as engineer with the duty of endeavoring to improve the quality of concrete being laid in that part of the state. Mr. Warren has previously been employed by county and state on highway work. In a letter to Director Lang of the Pittsburgh Department of Public Works outlining the contemplated work of Mr. Warren, it was stated that specifications on important work be complied with by those furnishing sand and gravel for concrete work. Another object is to bring uniformity of specifications by counties, cities and boroughs. The engineer also will visit construction jobs and observe whether the proper mixture of concrete is being made. Many other functions for the engineer were outlined.

Editorial Comment

Proposed Tariff

The tariff bill reported to the United States House of Representatives on May 7 by the ways and means committee contains provision for a duty of 8 cents per hundred or about 30 cents per barrel on portland cement. In the published reports at this writing there is no reference in the bill to other rock products on which protective tariffs were solicited, save that there is a proposed duty of $1.25 per M on brick, which will be a slight help to Eastern sand-lime-brick manufacturers. The portland cement manufacturers asked (modestly we believe) for a duty of 22 cents per hundred or 83.6 cents per barrel. Sand, gravel and crushed stone producers asked for 5 cents per hundred, or $1 per ton, protection from Canadian producers; domestic gypsum miners asked for $3 a ton or 15 cents per hundred on crude gypsum. All these commodities except crushed limestone are on the free list—as is portland cement from Belgium.

The hardest step for American producers and manufacturers in seeking adequate tariff protection is *to get off the free list,* once on it. The adjustment of the tariff, after any tariff at all is agreed upon, is easier than getting off the free list into the tariff schedule, because this requires an act of Congress. Therefore, if the present tariff bill is adopted, portland cement manufacturers will have accomplished more than would appear on the face of the proposed schedule. Had the sand, gravel and crushed-stone producers along the Canadian border concentrated their efforts on getting these commodities off the free list, irrespective of the amount of duty involved, undoubtedly they would have stood a better chance with the ways and means committee. But even then they would have encountered a great reluctance on the part of the government to put up tariff barriers against Canadian imports other than agricultural—for duties on agricultural products even the government dare not refuse under present conditions. (While the present tariff bill proposes a duty on certain Canadian lumber and shingles it seems doubtful if it will stay there.) If a tariff on Canadian crushed limestone is justified, undoubtedly tariffs on other crushed stone and sand and gravel are justified; but deep governmental policies, including the prospect of building a St. Lawrence international waterway, are involved in the tariff policy toward Canada.

The only hope producers who want tariff protection now have is to interest the congressmen from their districts and states in their behalf. The proposed tariff bill may be amended from the floor of the house on the motion of any member, properly carried. When the house of representatives is through with it, the bill goes to the senate, which may also amend it upon the motion of any senator, duly adopted. The amended bill then goes to a conference committee, representing both the senate and the house, and a compromise bill is effected which both houses are under obligations to adopt. So there is still an opportunity for those interests not given protection to be heard.

Get Behind This Proposal!

In the new tariff bill introduced by the ways and means committee the flexible tariff provisions of the present law are retained but modifications are proposed to make them more workable. The new bill makes it unnecessary in all cases to obtain foreign costs of production and provides for equalization of "conditions of competition in the principal markets of the United States between domestic articles and like or similar competitive imported articles." This is all the average American manufacturer or producer asks.

The federal tariff commission had a larger share in drafting this new tariff bill than it ever had in any previous tariff bill. There is everywhere a tendency to make the tariff adjustments in line with sound economics. No doubt every American producer or manufacturer who has had any experience in seeking a tariff or a tariff change would rather deal with the tariff commission, and trust to its knowledge of conditions and fairness of judgment, than to the ways and means committee of congress, made up as it usually is of small-town lawyers and politicians. The federal trade commission, from its every-day contacts, has considerable comprehension of business and industry, and their needs, while the majority of the members of the ways and means committee seldom have much of any knowledge of business. Therefore every reader should back this provision of the tariff bill.

Under the new tariff bill the President is still empowered to increase or decrease by not more than 50% existing rates of duty upon the basis of information furnished by the tariff commission. But, as under the present law, the President can not make shifts from free list to the dutiable list or vice versa. We believe this could well be amended, and if readers are writing to their congressman about the tariff bill, we urge them to suggest giving the President and the tariff commission adequate authority to protect American industry under any and all conditions. And we urge every reader to write to his congressman, and to express an opinion regarding the proposed tariff measures, whether the reader is personally or selfishly interested in some commodity tariff or not. Only through such letters from business men do congressmen know and feel that their statesmanship is being checked up by their constituents.

Financial News and Comment

RECENT QUOTATIONS ON SECURITIES IN ROCK PRODUCTS CORPORATIONS

Stock	Date	Bid	Asked	Dividend
Allentown P. C. 1st 6's[29]	5- 8-29	90	....	
Alpha P. C. new com.	5- 6-29	50	53	75c qu. Apr. 15
Alpha P. C. pfd.	5- 6-29	116	....	1.75 Mar. 15
American Aggregates com.[45]	5- 7-29	40	45	75c qu. Mar. 1
Amer. Aggregate 6's, bonds	5- 6-29	107	....	
American Brick Co., sand-lime brick	5- 6-29	....	15	25c qu. Feb. 1
American Brick Co. pfd., sand-lime brick	4-22-29	86½	87	50c qu. Feb. 1
Am. L. & S. 1st 7's[29]	5- 8-29	100	102	
American Silica Corp. 6½'s[40]	5- 7-29	96	100	
Arundel Corp. new com.	5- 7-29	39½	....	50c qu. Apr. 1
Atlantic Gyp. Prod. (1st 6's & 10 sh. com.)[10]	5- 8-29	70	80	
Atlas P. C. com.	5- 6-29	47	50	
Atlas P. C. pfd.	5- 6-29	50	....	66⅔c qu. Apr. 1
Beaver P. C. 1st 7's[20]	5- 2-29	98	100	
Bessemer L. & C. Class A[4]	5- 6-29	35	36	75c qu. May 1
Bessemer L. & C. 1st 6½'s[4]	5- 6-29	98	99	
Bloomington Limestone 6's[29]	5- 8-29	89	92	
Boston S. & G. new com.[16]	5- 6-29	20	23	
Boston S. & G. new 7% pfd.[16]	5- 6 29	50	52	
Canada Cement com.	5- 6-29	28	....	
Canada Cement pfd.	5- 6-29	97	97½	1.62½ qu. Mar. 30
Canada Cement 5½'s[11]	5- 4-29	99	101	
Canada Cr. St. Corp. 1st 6½'s[11]	5- 4-29	96	99	
Canada Gyp. & Alabastine	5- 6-29	108	110	75c Jan. 2
Certainteed Prod. com.	5- 7-29	24	25	
Certainteed Prod. pfd.	5- 7-29	55	57	1.75 qu. Jan. 1
Cleveland Stone new st'k	5- 7-29	70	....	50c June 1 & 50c Sept. 1
Columbia S. & G. pfd.	5- 6-29	90¾	92	
Consol. Cement 1st 6½'s, A[42]	5- 7-29	92	94	
Consol. Cement 6½% notes[29]	5- 8-29	78	82	
Consol. Cement pfd.[29]	5- 8-29	50	60	
Consol. Oka S. & G. 6½'s[12] (Canada)	5- 3-29	101	103	
Consol. S. & G. com. (Canada)	5- 6-29	18	....	
Consol. S. & G. pfd. (Canada)	5- 6-29	....	90	1.75 qu. May 15
Construction Mat. com.	5- 7-29	30	31	
Construction Mat. pfd.	5- 7-29	45½	46½	87½c qu. May 1
Consumers Rock & Gravel, 1st Mtg. 6's, 1948[18]	5- 2-29	97	99½	
Coosa P. C. 1st 6's[29]	5- 8-29	50	60	
Coplay Cem. Mfg. 1st 6's[40]	5- 7-29	90	....	
Coplay Cem. Mfg. com.[40]	5- 7-29	15	....	
Coplay Cem. Mfg. pfd.[40]	5- 7-29	75	....	
Dewey P. C. 6's[30] (1930-41)	5- 7-29	98½	....	
Dewey P. C. 6's[30] (1942)	5- 7-29	101½	....	
Dolese & Shepard[3]	5- 7-29	110	115	$2 qu. Apr. 1
Edison P. C. com.[39]	5- 6-29	10c	....	
Edison P. C. pfd.[39]	5- 6-29	25c	....	
Giant P. C. com.[25]	5- 3-29	38	....	
Giant P. C. pfd.[25]	5- 3-29	38	42	
Ideal Cement, new com.[33]	5- 4-29	75	77	75c qu. Apr. 1
Ideal Cement 5's, 1943[33]	5- 4-29	100	102	
Indiana Limestone units[29] (5 shs. com. & 1 sh pfd.)	5- 8-29	100	....	
Indiana Limestone 6's	5- 6-29	90	90⅛	
International Cem. com.	5- 7-29	93	94	$1 qu. Mar. 28
International Cem. bonds 5's	5- 7-29	105⅝	108¾	Semi-ann. int.
Iron City S. & G. bonds 6's[46]	5- 3-29	92	96	
Kelley Is. L. & T. new st'k	5- 7-29	57	60	62½c qu. Apr. 1
Ky. Cons. Stone Co. com.[48]	5- 2-29	14	15	
Ky. Cons. St. com. Voting Trust Certif.[48]	5- 2-29	14	15	
Ky. Cons. Stone 6½'s*[48]	5- 2-29	96	100	
Ky. Cons. St. Trustee Certif.[48] (1 Sh. 7% cum. pfd. & 1 sh. com. stock)	5- 2-29	99	102	
Lawrence P. C.	5- 6-29	93	98	
Lawrence P. C. 5½'s, 1942	4- 3-29	93½	95	
Lehigh P. C.	5- 7-29	59½	60	62½c qu. May 1
Lehigh P. C. pfd.	5- 6-29	110	110⅜	1¾% qu. July 1
Lyman-Richey 1st 6's, 1932[13]	5- 6-29	98	100	
Lyman-Richey 1st 6's, 1935[13]	5- 6-29	97	99	
Marblehead Lime 6's[14]	5- 3-29	98	100	
Material Service Corp.	5- 9-29	....	34½	50c qu. June 1
Mich. L. & C. com.[6]	5- 6-29	35	....	
Missouri P. C.	5- 7-29	44	44¼	50c qu. May 1
Monolith Midwest[9]	5- 2-29	8½	10	
Monolith bonds, 6's[9]	5- 2-29	97	98	
Monolith P. C. com.[9]	5- 2-29	14	14½	8% ann. Jan. 2
Monolith P. C. pfd.[9]	5- 2-29	9	9½	
Monolith P. C. units[9]	5- 2-29	32	33½	
National Cem. (Can.) 1st 7's[20]	5- 8-29	96	100	
National Gypsum A com.[3]	5- 7-29	15	17	
National Gypsum pfd.[3]	5- 7-29	45	50	
Nazareth Cem. com.[26]	5- 3-29	27	30	
Nazareth Cem. pfd.[26]	5- 3-29	100	105	
Newaygo P. C. 1st 6½'s[29]	5- 8-29	97	....	
New Eng. Lime 1st 6's[14]	5- 3-29	95	100	
N. Y. Trap Rock 1st 6's	5- 6-29	98½	98⅝	
North Amer. Cem. 1st 6½'s	5- 7-29	73⅝	75	
North Amer. Cem. com.[29]	5- 8-29	6	9	
North Amer. Cem. 7% pfd.[29]	5- 8-29	24	30	
North Amer. Cem. units[29]	5- 8-29	32	39	
North Shore Mat. 1st 5's[15]	5- 7-29	97	100	
Northwestern States P. C.[37]	4- 5-29	150	160	
Ohio River S. & G. 6's[16]	5- 6-29	94	97	
Pac. Coast Cem. 6's, A[5]	5- 2-29	92¾	96½	
Pacific P. C. com.[5]	5- 2-29	28½	31	
Pacific P. C. pfd.[5]	5- 2-29	80	84	1.62½ qu. Jan. 5
Pacific P. C. 6's[5]	5- 2-29	98¾	....	
Peerless Egyp'n P. C. com.[1]	5- 6-29	2⅛	2⅝	
Peerless Egyp'n P. C. pfd.[1]	5- 6-29	78	....	
Penn-Dixie Cem. 1st 6's	5- 7-29	94⅝	....	
Penn-Dixie Cem. pfd.	5- 7-29	82	83½	1.75 qu. Mar. 15
Penn-Dixie Cem. com.	5- 7-29	22	23½	
Penn. Glass Sand Corp. 1st 6's. 1952	4- 3-29	102½	103½	
Penn. Glass Sand pfd.	4- 3-29	110	....	
Petoskey P. C.	5- 7-29	10	10¾	1½% qu.
Riverside P. C. com.	4- 5-29	20	....	
Riverside P. C. pfd.[9]	5- 2-29	....	21	1.50 qu. May 1
Riverside P. C., A[20]	5- 2-29	....	21	31¼c qu. May 1
Riverside P. C., B[44]	5- 3-29	5	....	
Sandusky Cem.	3-28-29	248	....	$2 qu. Apr. 1
Santa Cruz P. C. bonds	5- 3-29	105¾	....	6% annual
Santa Cruz P. C. com.	5- 3-29	91	....	$1 qu. Apr. 1
Schumacher Wallboard com.	5- 3-29	16	17¼	
Schumacher Wallboard pfd.	5- 3-29	23½	25	
Southwestern P. C. units[44]	5- 3-29	275	....	
Standard Paving & Mat. (Can.) com.	5- 6-29	34	35	50c qu. May 15
Standard Paving & Mat. (Can.) pfd.	5- 6-29	....	98½	1.75 qu. May 15
Superior P. C., A[20]	5- 2-29	43⅝	43⅞	27½c mo. Mar. 1
Superior P. C., B[20]	5- 2-29	30¼	33	
Superior P. C. com.	5- 3-29	97	....	
Trinity P. C. units[37]	4- 5-29	155	....	
Trinity P. C. com.[29]	5- 8-29	54	58	
Trinity P. C. pfd.[29]	5- 8-29	99	....	
U. S. Gypsum com.	5- 7-29	65½	66	2% qu. June 30
U. S. Gypsum pt. paid	5- 7-29	51	52	
U. S. Gypsum pfd.	5- 7-29	125	126	1¾% qu. June 30
Universal G. & L. com.[3]	5- 7-29	....	1	
Universal G. & L. pfd.[3]	5- 7-29	....	10	
Universal G. & L., V.T.C.[3]	5- 7-29	No market		
Universal G. & L. 1st 6's[3]	5- 7-29	....	60	
Chas. Warner com.[16]	5- 6-29	35	40	50c qu. Apr. 15
Chas. Warner pfd.[16]	5- 6-29	110	....	1¾% qu. Apr. 25
Whitehall Cem. Mfg. com.[36]	5- 3-29	150	....	
Whitehall Cem. Mfg. pfd.[36]	5- 3-29	98	....	
Wisconsin L. & C. 1st 6's[15]	5- 7-29	98	101	
Wolverine P. C. com.	5- 7-29	6½	7	15c qu. May 15
Yosemite P. C., A com.[20]	5- 2-29	4¾	5¼	

*Ann. interest due May 1 and Nov. 1. Semi-ann. coupon of $32.50 paid Nov. 1.

[1]Quotations by Watling Lerchen & Hayes Co., Detroit, Mich. [2]Quotations by Bristol & Willet, New York. [3]Quotations by Rogers, Tracy Co., Chicago. [4]Quotations by Butler, Beading & Co., Youngstown, Ohio. [5]Quotations by Freeman, Smith & Camp Co., San Francisco, Calif. [6]Quotations by Frederic H. Hatch & Co., New York. [7]Quotations by F. M. Zeiler & Co., Chicago, Ill. [8]Quotations by Ralph Schneeloch Co., Portland, Ore. [9]Quotations by A. E. White Co., San Francisco, Calif. [10]Quotations by Lee Higginson & Co., Boston and Chicago. [11]Nesbit, Thomson & Co., Montreal, Canada. [12]James Richardson & Sons, Ltd., Winnipeg, Man. [13]Peters Trust Co., Omaha, Neb. [14]First Wisconsin Co., Milwaukee, Wis. [15]Central Trust Co. of Illinois, Chicago. [16]J. S. Wilson, Jr., Co., Baltimore, Md. [17]Chas. W. Scranton & Co., New Haven, Conn. [18]Dean, Witter & Co., Los Angeles, Calif. [19]Hoit, Rose & Troster, New York. [20]Quotations by Bond & Goodwin & Tucker, Inc., San Francisco. [21]Baker, Simonds & Co., Inc., Detroit. [22]Pirnie, Simons and Co., Springfield, Mass. [23]Blair & Co., New York and Chicago. [24]A. B. Leach & Co., Inc., Chicago. [25]Richards & Co., Philadelphia, Penn. [26]Hincks Bros. & Co., Bridgeport, Conn. [27]J. G. White & Co., New York. [28]Mitchell-Hutchins Co., Chicago, Ill. [29]National City Co., Chicago, Ill. [30]Chicago Trust Co., Chicago. [31]McIntyre & Co., New York, N. Y. [32]Hepburn & Co., New York. [33]Boettcher-Newton & Co., Denver, Colo. [34]Kidder. Peabody & Co., Boston, Mass. [35]Farnum, Winter & Co., Chicago. [36]Hanson and Hanson, New York. [37]S. F. Holzinger & Co., Milwaukee, Wis. [38]McFetrick & Co., Montreal, Que. [39]Tobey and Kirk, New York. [40]Steiner, Rouse and Stroock, New York. [41]Hornblower & Weeks, New York City and Chicago. [42]E. H. Rollins, Chicago, Ill. [43]Jones, Heward & Co., Montreal, Que. [44]Tenney, Williams & Co., Inc., Los Angeles, Calif. [45]Taylor Ewart & Co. [46]Stein Bros. & Boyce, Baltimore, Md. [47]Bank of Pittsburgh, Pittsburgh, Pa. [48]E. W. Hays & Co., Louisville, Ky. [49]Blythe Witter & Co.

INACTIVE ROCK PRODUCTS SECURITIES (Latest Available Quotations)

Stock	Price bid	Price asked
American Brick Co. pfd. (sand-lime brick) 16 sh.[6]	par 25	25¾
American Brick Co. pfd., 5 sh.[2] (par 25)	25	....
Atlantic Gypsum Products[6] com., 200 shares	$2 per share	....
International Portland Cement Co., Ltd., pfd.	30	45
Knickerbocker Lime Co.[4]	105	....
Seaboard P. C.[1] 6% bonds ($7,500) 7-1-27. July, 1910, and subsequent coupons attached	$10 for the lot	....
Southern Phosphate Co.[6]	1¾	....
Universal Gypsum com. free stk.[1] 300 shares	$75 for the lot	....
Universal Gypsum com.[1] 153 shares (no par)	$51 for the lot	....
Vermont Milling Products Co. (slate granules), 22 sh. com. and 12 sh. pfd.[6]	$1 for the lot	....
Winchester Brick Co., pfd., sand lime brick[5]	10c	....
Winchester Rock Brick Co. pfd., 1 share (par $25) and 1 share com. (par $10)[6]	$8 for the lot	....

[1]Price obtained at auction by Adrian H. Muller & Sons, New York. [2]Price at auction by R. L. Day & Co., April 24, 1929. [4]Price obtained at auction by Barnes and Lofland, Philadelphia, on April 4, 1928. [5]Price obtained at auction for lot of 50 shares by R. L Day & Co., Boston, Mass. [6]Price obtained at auction by Wise, Hobbs and Arnold, Boston, Mass.

Annual Report Rockland and Rockport Lime Corp. for 1928

AS A RESULT of continued competitive market conditions, the operations of the Rockland and Rockport Lime Corp. show a net deficit for the 12 months ending December 31, 1928. Other extracts from the report of the corporation's president, George B. Wood, follow: It has been necessary, under the circumstances, to conserve all resources, and the directors deemed it for the best interests of the stockholders to defer payment of the dividends on the preferred stock, due August 1, 1928, and due February 1, 1929.

During the year the company expended $86,614.94 for important plant improvements and additions, and manufacturing costs have been further reduced by the consolidation of operations into one large plant unit in Rockland. Volume of lime sales was in excess of sales for the previous year.

During the last half of the year, the new plant of the Hoosac Valley Lime Co., Inc., at Adams, Mass., was in production. The lime produced is of excellent quality and is meeting with growing favor in all of the markets where it has been introduced. Manufacturing costs are remarkably low, and the results of the first six months' operations indicate that the building of the new modern plant will prove a profitable investment.

In the New York territory—the company's principal market for building lime—prices reached a point below the level of possible manufacturing cost. Throughout the entire year, competitive manufacturers from various localities sought this market as an outlet for surplus production, and persistently sold at lower than the Rockland company's established prices.

If keen competitive selling continues for a long enough period, it generally leads to the re-establishment of standardized and business-like practices, and it is hoped that a return to more normal conditions will be brought about in the lime industry.

STATEMENT OF ASSETS AND LIABILITIES OF THE ROCKLAND AND ROCKPORT LIME CORP., DEC. 31, 1928

ASSETS

Current assets:		
Cash	$ 36,403.47	
Notes receivable	15,391.40	
Accounts receivable	114,564.98	
Lime and supplies	262,375.46	
Total current assets		$ 428,735.31
Plant and fixed assets:		
Land, building, plant equipment, quarries and miscellaneous equipment	$2,850,452.30	
Less allowance for depletion and depreciation	588,009.70	
		$2,292,442.60
Treasury stock (at cost):		
1,608.8 shares second preferred, 687 shares common		77,939.80
Subsidiary companies:		
Investments in and advances to subsidiary companies		581,903.08
Other assets:		
Miscellaneous notes and accounts receivable and investments, including sinking funds	$ 12,697.74	
Deferred charges to future operations	13,384.81	
		$ 26,082.55
		$3,407,103.34

LIABILITIES

Current liabilities:		
Note payable (Secured by mortgage on plant and equipment acquired by absorption of former subsidiary; due July 28, 1929.)	$ 5,000.00	
Accounts payable	30,514.23	
Rockland Transportation Co.	30,400.00	
Accrued bond interest, wages, etc.	29,120.40	
Total current liabilities		$ 95,034.63
Deferred liabilities:		
Notes payable (Secured by mortgage on plant and equipment acquired by absorption of former subsidiary; due in equal annual installments, July 28, 1930, to July 28, 1939.)		40,000.00
Bonded indebtedness:		
First mortgage 20-year 6% sinking fund gold bonds, due February 1, 1940		544,500.00
Reserves:		
For insurance on lighters and cargoes and repairs to lighters		25,041.09
Capital stock:		
First preferred 7% cumulative	$1,024,275.00	
Second preferred 6% non-cumulative	587,500.00	
Common	850,000.00	
		$2,461,775.00
Surplus		240,779.62
		$3,407,103.34

Note "A": At the above date the corporation was contingently liable as guarantor of the first mortgage 6% gold bonds, due 1947, of the Hoosac Valley Lime Co., Inc., in the amount of $300,000; as guarantor of the first mortgage 6½% marine equipment bonds, due 1937, of the Rockland Transportation Co. in the amount of $157,000, and as endorser of secured notes receivable of the Rockland Transportation Co. discounted in the amount of $25,000.

Note "B": One semi-annual dividend of $35,843.50 on the 7% cumulative first preferred stock was in arrears at the above date.

CONDENSED COMBINED INCOME AND EXPENSE AND SURPLUS OF THE ROCKLAND AND ROCKPORT LIME CORP. AND SUBSIDIARY COMPANIES FOR THE YEAR ENDED DECEMBER 31, 1928

	Rockland and Rockport Lime Corp.	Hoosac Valley Lime Co., Inc.	Lime Rock Railroad Co.	Rockland Transportation Co.	Total
Gross income	$1,295,405.88	$202,396.93	$139,596.32	$54,900.00	$1,692,299.13
Operating expenses	1,322,894.29	175,742.18	101,744.14	15,892.35	1,616,272.96
Net operating profit or loss	$ 27,488.41	$ 26,654.75	$ 37,852.18	$39,007.65	$ 76,026.17
Other income or deductions (net)	5,809.56	3,782.67	2,187.84	1,133.44	1,294.39
Net profit or loss before interest, depletion and depreciation	$ 21,678.85	$ 22,872.08	$ 35,664.34	$37,874.21	$ 74,731.78
Interest, depletion and depreciation	94,289.64	26,552.64	17,742.52	20,536.43	159,121.23
Available for dividends (loss)	$ 115,968.49	$ 3,680.56	$ 17,921.82	$17,337.78	$ 84,389.45
Dividends paid	35,843.50	....	....	9,000.00	44,843.50
Net profit or loss carried to surplus	$ 151,811.99	$ 3,680.56	$ 17,921.82	$ 8,337.78	$ 129,232.95
Surplus additions or deductions	43,594.20	280.27	....	3,841.25	47,155.18
Total	$ 108,217.79	$ 3,960.83	$ 17,921.82	$12,179.03	$ 82,077.77
Surplus January 1, 1928	348,997.41	90,756.91	129,871.93	29,763.94	599,390.19
Surplus December 31, 1928	$ 240,779.62	$ 86,796.08	$147,793.75	$41,942.97	$ 517,312.42

Note: No depletion has been charged to operations during the current year on the books of the Rockland and Rockport Lime Corp.

Bessemer Limestone and Cement Company

STOCKHOLDERS of the Bessemer Limestone and Cement Co., Youngstown, Ohio, on April 8 approved the annual statement in which it was shown that Bessemer net earnings for 1928 were $816,283. Bonded indebtedness was reduced by retirement and purchase for the treasury to $2,279,500.

G. G. Treat, treasurer of the company, has replaced H. N. Snyder of Buffalo, N. Y., as a member of the board of directors.—*Wall Street News.*

International Cement First Quarter Earnings

INTERNATIONAL CEMENT CORP., New York City, reports for the quarter ended March 31 net income of $1,017,619 after depreciation, federal taxes and other charges, equal to $1.64 a share on 618,924 common shares, as against $1,067,928 or $1.60 a share on 562,500 common shares after preferred dividends in the first quarter of 1928. The profit and loss statement follows:

FIRST QUARTER

Gross sales	$7,491,036.14	
Less: Packages, discounts and allowances	1,533,810.81	
Net sales	$5,957,225.33	
Manufacturing cost excluding depreciation	$2,923,110.72	
Depreciation	446,368.58	
	$3,369,479.30	
Manufacturing profit	$2,587,746.03	
Shipping, selling and administrative expenses	1,173,899.61	
Net profit	$1,413,846.42	
Less: Interest charges and financial expenses	147,722.06	
	$1,266,124.36	
Reserves for federal taxes and contingencies	248,504.77	
Net to surplus	$1,017,619.59	

Marblehead Lime Company Offers New Bonds

THE FIRST WISCONSIN CO., Milwaukee, Wis., recently offered at 100 a new issue of $600,000 first mortgage 6% serial gold bonds of the Marblehead Lime Co., Chicago, Ill., which has been practically fully sold. The following, from a letter by Bernard L. McNulty, president of the company, to the bankers, gives the purpose of this bond issue:

HISTORY AND BUSINESS—The Marblehead Lime Co. is a Delaware corporation, organized in 1922. It is successor to a business founded in 1872 and is one of the largest producers of high-calcium lime in the middle west. The company, with headquarters in Chicago, owns properties at

South Chicago, Marblehead and Quincy, Ill.; and at Hannibal, Springfield, Louisiana and White Bear, Mo. The average annual production from the quarries of the Marblehead Lime Co. for the past five years was over 150,000 tons of limestone.

The Marblehead Lime Co. constructed a plant in 1926 at South Chicago, which is the most modern lime plant in the United States. Its two rotary kilns, with a daily capacity of 300 tons of pebble lime, are the largest of their kind in the world.

The company's product is sold for use in widely diversified industries, including the following: Building trades, chemical, metallurgical, paper and fertilizer industries and to municipalities for water purification and sewage disposal. The company has been developing the processing of its lime to make it suitable for various specialized purposes, and the convenience of package lime has created a demand for pulverized quicklime and opened up new avenues for its use.

PURPOSE OF ISSUE—The proceeds from the sale of this issue will be used for the retirement of the outstanding 7% first mortgage bonds, for the retirement of the 5½% gold notes, the acquiring of the fee of the South Chicago plant and for other corporate purposes.

SECURITY—These bonds are a direct obligation of the Marblehead Lime Co. and are secured by a first mortgage on all the real estate and fixed assets of the company now owned or hereafter acquired. The depreciated book value of the fixed assets, as of November 30, 1928, was $1,663,837.

The balance sheet of the company as of November 30, 1928, as certified to by Arthur Andersen and Co., after giving effect to this financing, shows net tangible assets of $3170 for each $1000 bond of this issue.

EARNINGS—The net earnings of the Marblehead Lime Co. as certified to by Arthur Andersen and Co. for the past six years are as follows:

Fiscal year ended November 30	Before depreciation and depletion	After depreciation and depletion
1923	$218,927.29	$184,885.70
1924	181,788.67	144,765.85
1925	168,930.59	129,944.65
1926	87,876.25*	48,197.87*
1927	127,030.34	58,534.61
1928	162,010.43	91,825.71

*The high cost of operating the South Chicago plant, built in 1926; the introduction of lime in a new form, and a general decline in the market price of lime were the contributing causes to the low earnings shown in 1926 and 1927.

The average annual net earnings after depreciation and depletion for the last six years as shown above were over three times the maximum annual interest requirements on this issue.

CAPITALIZATION—The capitalization of the company upon completion of this financing will be as follows:

	Authorized	Outstand'g
First mortgage 6% serial gold bonds	$1,000,000	$600,000
Preferred stock, Class "A"	11,500	11,500
Preferred stock, Class "B"	460,000	331,500
Common stock, no par, shs.	16,000	14,000

DESCRIPTION OF BONDS—The $600,000 principal amount of these bonds will be in coupon form, registerable as to principal and interest and will be issued in denominations of $1000, $500 and $100. They will bear interest at the rate of 6% per annum, payable semi-annually on the first days of January and July in each year, and both principal and interest will be payable at the office of the First Wisconsin Trust Co., Milwaukee, Wis. These bonds will be callable for redemption in whole or in part at the option of the company upon 30 days' published notice on any interest date at par and interest plus a premium of one-half of 1% for each year or portion thereof between the call date and the maturity of the bonds called.

MATURITIES

$ 30,000	January 1, 1930
30,000	January 1, 1931
30,000	January 1, 1932
35,000	January 1, 1933
35,000	January 1, 1934
35,000	January 1, 1935
35,000	January 1, 1936
35,000	January 1, 1937
35,000	January 1, 1938
300,000	January 1, 1939

$1,000 denominations are available in all maturities; $500 and $100 denominations are available only in the 1939 maturity.

PROVISIONS OF THE TRUST INDENTURE—Bonds in the amount of $600,000 are issued under a trust indenture made to the First Wisconsin Trust Co. and George B. Luhman, Milwaukee, Wis., and Mississippi Valley Trust Co. of St. Louis, trustee, which, among other things, provides that:

1. Additional bonds not to exceed $400,000 par value may be issued upon real estate and fixed assets of the company provided:

(a) That the company acquires real estate and fixed improvements to the trust estate, said additional bonds not to exceed 60% of the cost of the real estate acquired or fixed improvements made.

(b) That the net yearly earnings of the company available for bond interest, depreciation and income taxes for the preceding two fiscal years have not been less than three times the annual interest on all the bonds thereafter to be outstanding.

(c) That the total amount of bonds outstanding, including the issuance of additional bonds, shall not be more than 50% of the sound value of the total real estate and fixed improvements of the company.

2. The company will keep its property insured against loss or damage by fire and other casualties to a reasonable value thereof, making any losses thereunder payable to the trustees as the interest of the trustees may appear by the usual mortgagee and trustee clauses.

3. The company will furnish annually a report of its operations to the trustee prepared by auditors satisfactory to the trustee.

PRO FORMA BALANCE SHEET OF THE MARBLEHEAD LIME CO., NOVEMBER 30, 1928
(After giving effect to sale of $600,000 of first mortgage 6% serial gold bonds and retirement of present outstanding 7% bonds, 5½% notes, and contract obligation plus $80,000 of bank loans)

ASSETS

Current assets:			
Cash		$ 29,359.86	
Receivables		77,876.46	
Inventories certified by the management as to quantities and condition, priced at cost or market, whichever lower (raw materials based on perpetual book inventory)		172,368.44	
Total current assets			$ 279,604.76
Other assets			45,718.66
Deferred charges to future operations:			
Bond discount and expense		$ 52,000.00	
Other deferred charges		14,236.43	66,236.43
Fixed assets:			
Limestone deposits and real estate as valued by the company's officials on November 30, 1922—			
Limestone deposits	$489,433.33		
Less—Reserve for depletion	34,259.29	$ 455,174.04	
Real estate		192,436.16	
Buildings, kilns and equipment at sound value as appraised by the Audit Co. of New York on June 6, 1922, plus additions at cost less depreciation provision since		1,016,227.24	1,663,837.44
			$2,055,397.29

LIABILITIES AND NET WORTH

Current liabilities:			
Notes payable		$ 37,098.80	
Accounts payable		94,976.34	
Interest and taxes accrued		21,201.63	
Total current liabilities			$ 153,276.77
First mortgage 6% serial gold bonds, due January 1, 1930 to 1939, to be presently outstanding			600,000.00
Net worth:			
Capital stock—7% cumulative preferred of $100 par (callable at 110)—			
Series A—400 shares authorized	$ 40,000.00		
Less—285 shares redeemed	28,500.00	$ 11,500.00	
Series B—4600 shares authorized	460,000.00		
Less—1000 shares unissued and 285 shares in treasury	128,500.00	331,500.00	
Common stock of no par value—authorized 16,000 shares, issued 14,000 shares		768,514.27	
Surplus		190,606.25	1,302,120.52
			$2,055,397.29

Recent Dividends Announced

Cleveland Stone com. (quar.)	50c June 1 & 50c Sept. 1
Consolidated Sand & Gravel (Toronto) pfd. (quar.)	$1.75, May 15
Construction Materials pfd. (quar.)	87½c, May 1
Lehigh P. C. pfd. (quar.)	$1.75, July 1
Material Service (quar.)	50c, June 1
Missouri P. C. (quar.)	50c, May 1
International Agric. Corp. prior pfd. (quar.)	1¾%, June 1
Pacific Lime Co., Ltd.	1¾%, Apr. 8
Pacific Lime Co., Ltd., pfd. (quar.)	1¾%, Apr. 1
Riverside P. C. Cl. A (quar.)	31¼c, May 1
Riverside P. C. pfd. (quar.)	$1.50, May 1
Standard Paving & Mat'ls. (Toronto) com. (quar.) No. 1	50c, May 15
Standard Paving & Mat'ls. (Toronto) pfd. (quar.) No. 1	$1.75, May 15
U. S. Gypsum com. (quar.)	40c, June 30
U. S. Gypsum pfd. (quar.)	$1.75, June 30
U. S. Asbestos com. (quar.)	75c, May 1
U. S. Asbestos pfd. (quar.)	1¾%, May 1
Wolverine P. C. (quar.)	15c, May 15
Virginia-Carolina Chem. 7% pr. pfd. (quar.)	$1.75, June 1

Gordon F. Daggett in New Location

GORDON F. DAGGETT, former executive secretary of the Wisconsin Mineral Aggregates Association, is now chief engineer of the Boebrick Machinery Co., Milwaukee, Wis., dealers in contractors' and industrial equipment. Mr. Daggett is a graduate civil engineer of the University of Wisconsin, and has achieved quite a reputation in the sand and gravel industry as a designing engineer of plants, and as a consulting engineer on production and operating problems. He was chairman of the committee on tests of the National Sand and Gravel Association. He will have entire charge of all designing and construction for the Boebrick company.

Gordon F. Daggett

New Lime Products Enterprise for Oregon

DEVELOPMENT of the lime deposits of the Applegate valley near Medford, Ore., and the manufacture of byproducts thereof, on a commercial basis, has been launched by J. H. Weber of Los Angeles and T. Henry Callaghan of Medford. They have formed a corporation, to be known as the Standard Products, Inc., for the manufacture of lime fertilizers and sand-lime bricks. They plan to start construction at once. Negotiations for the deal were completed March 11.

The company will work the "Cameron deposit," on the Applegate river, 3½ miles below Ruch.

They will erect a warehouse in Medford, one at Ruch for the assembling of the products and a plant at the quarry for manufacturing purposes. They will also erect a lime-burning plant.

When the plant is in full operation they will employ regularly about 50 men.

The incorporation includes the present plant of the Standard Roofing and Products Co. of Medford, which will continue its present business.

It is expected that the output of the plant will be 25 tons per day, or slightly more than a carload.

The "Cameron deposit" consists of high grade, lime rock, of snow whiteness, and is within easy accessibility of the county road. It is estimated there are 20,000,000 tons of lime available. The company recently purchased 15 acres at Ruch, which they will use for storage of material. A portion of the material to be used in the fertilizer will be transported from the Blue Ledge. Assays of the lime and tests over a period of many months has demonstrated its economic practicability.

It is the plan of the company to market its products in the Pacific coast states and to ship them in specially made paper sacks. The fertilizer, the assays show, is of an exceptional high grade. The brick, the backers of the project hold, can be produced in 28 hours, ready for construction, against the weeks needed for the manufacture of the ordinary building brick. The sand-lime brick is claimed to be not so absorbent, enhancing its building value.

J. H. Weber will be president and manager of the company. He was formerly in the lumber business in southern California.

Henry Callaghan, the other member of the firm, is a well-known resident of Medford, for many years interested in mining development projects.

The company is incorporated for $25,000, sells no stock and will erect its plant and warehouses out of its own brick.—*Medford* (Ore.) *Mail-Tribune.*

Madison Sand and Gravel Corp. Completing New Plant in Pennsylvania

THE Madison Sand and Gravel Corp. of Hamilton, N. Y., has nearly completed its new plant at Susquehanna, Penn., and will be operating within a month, according to John G. Carpenter, president of the company. The new plant will be operated at present with a drag scraper in the pit, but it is contemplated that a dredge outfit may be installed at a later date. The scraper now installed is a Beaumont.

The Madison corporation last fall sold its previous plant at Solsville, N. Y., to the Rock Cut Stone Co. of Syracuse. It has not been operating any producing plant since that time, but the opening of the new plant will place it in position to meet the demands of the coming season.

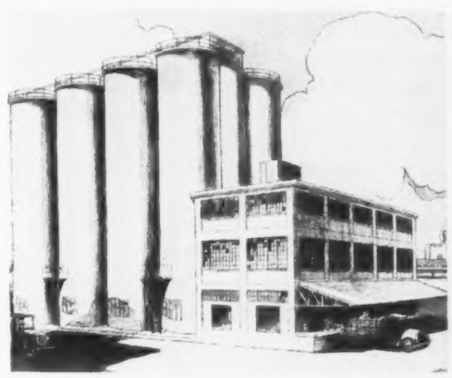
Roy Wilcox Building New Sand Plant Near Grants Pass, Ore.

ROY WILCOX, who has been engaged for several years in the gravel and rock crushing business at Grants Pass, Ore., in the west part of the city on the river, has started construction of a new plant near the White Rocks, east of Grants Pass and on the south side of the river. Mr. Wilcox expects to be ready to operate at the new location by the last of July. He has 18 acres of land and a spur extends to the new location from the California and Oregon Coast railroad. He will move his present plant and will add considerable new equipment, making the new plant one of the most modern in the state. His output will be increased to 300 cu. yd. a day.

Foundations have already been poured, one carload of cement being used in this work. Two more carloads of cement are to be used in the remainder of the construction.—*Grants Pass* (Ore.) *Courier.*

Lone Star Cement Co., Virginia, to Build Washington Warehouse

THE International Cement Corp. has announced plans for a large reinforced concrete warehouse for cement with a complete cement packing plant, now in the course of construction, on the Potomac river in Washington, D. C., at 34th and K streets.



Artist's drawing of the new pack house and storage silos of the Lone Star Cement Co., Virginia

A temporary warehouse at this location is now in service and will be used until the new plant is completed. The Washington plant, which will be operated by the Lone Star Cement Co., Virginia, Inc., an International subsidiary, will have a capacity of 60,000 bbl. of cement and will consist of eight silos, each 80 ft. in height, together with elevating and conveying equipment.

Cement is now being shipped to the Washington warehouse by barge from the plant of the Lone Star Cement Co., Virginia, Inc., at South Norfolk. Special marine equipment is being used for this purpose. In addition to "Lone Star" brand cement, the new warehouse will also supply "Incor" cement, a high-early-strength portland cement.

Foreign Competition Closes Alabama Mills of the International

AFTER OPERATING on a greatly reduced output for almost a year, the North Birmingham mill of the Lone Star Cement Co. of Alabama, Birmingham, Ala., closed for an indefinite period March 30. Low-priced foreign cement admitted duty-free under the present tariff schedule, was given as a reason for the shut-down.

The Spocari, Ala., mill of the Lone Star Cement Co. of Alabama ceased operations early in the month and the shut-down at the North Birmingham mill leaves the company without a kiln in operation.

Statement by J. W. Johnston

"We have kept our mills going just as long as we have had storage space for the cement produced," J. W. Johnston, vice-president of the company, said in explaining the shut-down. "We have operated at a reduced capacity for almost a year in an effort to keep as many men as possible on the payroll over an extended period. Now we face the accumulated effect of the continued and extensive use of imported cement. At a time when normal building activity should keep our mills working to capacity to meet the demand, we find our storage bins filled and we have no alternative. We must temporarily stop production.

"The wage scale paid the European cement worker is approximately one-fifth the wage scale paid the Birmingham cement worker." Belgium has been the principal exporter to the United States., and cement from that country as well as from other foreign countries, does not carry any import duty. The result is, well-paid American workmen are placed in direct competition with poorly paid Belgium workmen. Cheap labor plus low transportation costs, makes it possible for the foreign manufacturer to offer his product in the territory served by Birmingham mills at a price lower than we can meet.

Widespread Effects of Imports

"The result of this competition is not felt in the cement industry alone, nor in Birmingham alone. Most cement manufacturers on the Atlantic coast have been operating at a reduced output for several years, with thousands of cement workers unemployed.

"The Lone Star Cement Co. of Alabama, like other American cement manufacturers, is contesting the invasion of its legitimate market, by reducing prices to a point where there is little or no profit. We have made well-founded appeals to the loyalty, as well as the self-interest, of the American public—pointing out the fact that the disruption of the cement industry affects not only the cement worker, but has an effect on co-related industries, and on retailers, wholesalers and manufacturers who must depend upon workers in these industries for their trade.

"Until we are successful in our efforts to maintain our rightful markets by securing an import duty on cement that will equalize the overwhelming difference in wages and protect the American workman from unfair competition that is undermining the American standards of living, we cannot operate our mills. We have done everything possible to keep our men employed—but now that our bins are filled we have no choice—the mills must close."—*Birmingham* (Ala.) *Post.*

Propose Superphosphate Plant at Tampa

PREPARATION of a site on the east side of Hillsborough Bay, Tampa, Fla., for the construction of a giant phosphoric acid plant, estimated to involve the expenditure of $2,500,000 to $4,000,000, will be started within the next few months, H. L. Mead, Florida manager of the American Cyanamid Co., New York, said in announcing the purchase of the tract. The plant will, it is said, give employment to 250 to 400 persons and provide manufacturing facilities in Florida for the company, which is one of the largest pebble phosphate operators in the state, and is now spending $300,000 to open up a new deposit at Sidney, about 19 miles from Tampa. Negotiations for the site have been under way for several months. The tract, purchased from the East Tampa Bay Co., W. B. Gray, president, consists of 268 acres.

The company's plans call for a fill adjacent to the land purchased, which ultimately will cover as much area as was bought, and the plant will be erected on the fill, the idea being to locate the plant as close to deep water as possible. Borings are being made preparatory to dredging a channel from the main ship channel to the plant site. Contract for the dredging may be let within 60 days. The dredged material will constitute the fill on which the plant buildings will be erected. The initial construction will be the erection of a dock.

The plant will be served by the Atlantic Coast Line and the Seaboard Air Line railroads. The company now ships the products of its Florida mines to plants in other states for manufacture into finished products. The new plant will make possible the shipping by either rail or water of superphosphate. Large quantities of fuel oil and sulphur will be used. It is said that the product contains from 45 to 50 units of plant food, compared with ordinary acid-phosphate, which contains about 16 units.

The American Cyanamid Co. operates plants at Niagara Falls and at Warners, N. J., with wholly owned subsidiaries in California and Spain. Headquarters in Florida are at Brewster, in Polk county, where the company owns about 15,000 acres of phosphate lands. Other properties are at Green Bay and Sidney.—*Manufacturers' Record.*

Southern Sand and Gravel Association Formed

WITH more than 75 sand and gravel firms of the south represented, the Southern Sand and Gravel Association was formed at a meetnig held in Memphis, Tenn., at the Hotel Peabody on April 25th.

W. W. Fischer, of the Fischer Lime and Cement Co., Memphis, was elected president, with C. B. Ireland, Montgomery, Ala., vice president; H. B. Weston, of the Weston Sand and Gravel Co., Logstown, Miss., secretary, and V. A. Cordes, Wolf River Sand and Gravel Co., Memphis, treasurer.

The first annual convention of the new association will be held in Memphis next January, it was decided at the organization meeting. The membership of the association is open to producers in all southern states and leading firms of the south are represented on the rolls.—*Memphis* (Tenn.) *Commercial Appeal.*

Registration Is Denied to Word "Rocklath" for Plaster-Board

REGISTRATION to applicant of the notation "Rocklath" as a trademark for plaster-boards and plaster wallboards, was denied upon a finding that the opposer was first in the field and used the notation "Locklath" upon goods having the same descriptive properties, it being stated that while the first portions of each of the marks were quite dissimilar in significance yet they were so alike in spelling and sound that the marks as a whole were deemed confusingly similar.

A part of the text of the opinion of First Assistant Commissioner of Patents Kinnan follows:

This case comes on for review, on appeal of the applicant, United States Gypsum Co., of the decision of the examiner of trade-mark interferences sustaining the opposition filed by Plastoid Products, Inc., and adjudging the applicant not entitled to the registration for which it has applied.

The applicant seeks registration of the notation "Rocklath" used upon plaster-boards and plaster wallboards. The opposer sets up adoption and ownership of the notation "Locklath" used upon identically the same kind of goods, namely, plaster-board and plaster wallboard.

The testimony submitted on behalf of the applicant satisfactorily establishes the use of the notation "Rocklath" continuously since June, 1925.

The testimony submitted on behalf of the opposer is deemed to satisfactorily establish use by it of the notation "Locklath" continuously since at least several years prior to the date established by the applicant.

Hazards of Material Handling

Paper Presented by H. W. Gabor, Safety Engineer, New York State Insurance Fund, at the Regional Safety Meeting of the Portland Cement Association, at Albany, N. Y., April 16, 1929

THE PREVENTION OF ACCIDENTS in the handling of material has been a major problem since the dawn of history, from the building of the pyramids in Egypt with their stones weighing as much as 1000 tons each, down to the present day of industrial advancement. Whether the material be heavy or light, each has its own accident problem; heavy materials in their individual weight and lighter articles because of their number or other character present a hazard to the workers.

The problem can be resolved into better form by listing the various materials according to the potential hazard of each in your industry.

1. Explosives
2. Sharp or rough objects
3. Heavy objects
4. Bulk
5. Heat
6. Abrasives
7. Corrosives
8. Slippery objects

The hazards attached to the handling of explosives such as dynamite and blasting caps are so well known, apparently, that it may seem superfluous to mention them; but, about every so often, a serious injury occurs in the handling of explosives, to one or more of the men employed in a quarry. Investigation usually reveals that the underlying cause of the accident is one of tendencies in industry which we find it most difficult to correct, namely, that familiarity breeds contempt; wherefore, we have the slogan that "A moment of carelessness may mean a lifetime of regret."

The safe location of magazines is very important, to avoid having them struck by flying rock or have a stone slide down from the overburden and strike them. A few years ago an accident of this type caused the death of two men in a cement plant quarry. The wise quarry foreman will watch his overburden to keep it cleared back from the face, to prevent earth and stone falling and injuring his men.

H. W. Gabor

The handling of sharp or rough objects such as rock causes numerous injuries to hands and feet, which make up the bulk of accidents in most quarries, and for the prevention of which we use safety type shoes, gloves, etc.

Good Housekeeping Important

It is a safe statement to make that a clear, clean and neat quarry is a safe quarry. We have seen many cement plant quarries that were absolutely safe places for the men to work, and the men worked safely, the record showing at the end of the year that the precautions which had been taken were continued by the workers as part of the system.

It is astonishing what a vast amount of material will accumulate in a quarry in a short time. A complete cleanup is necessary at regular intervals in order to remove obstructions and to make the operations by the men count for production and safety, without hindrance or the necessity of continually walking around something.

The storage and laying of ties and tracks is another important item in the safety program of a quarry to make certain that they are handled only when necessary, that in the meantime they are in a safe place, out of the way but readily available when needed. Of course not all quarries are so laid out, nor can they always be so worked that an ideal plan can be made of the railroad. Nevertheless, it is well to recognize the importance of this as a factor in avoiding accidents in the handling of material in the quarry.

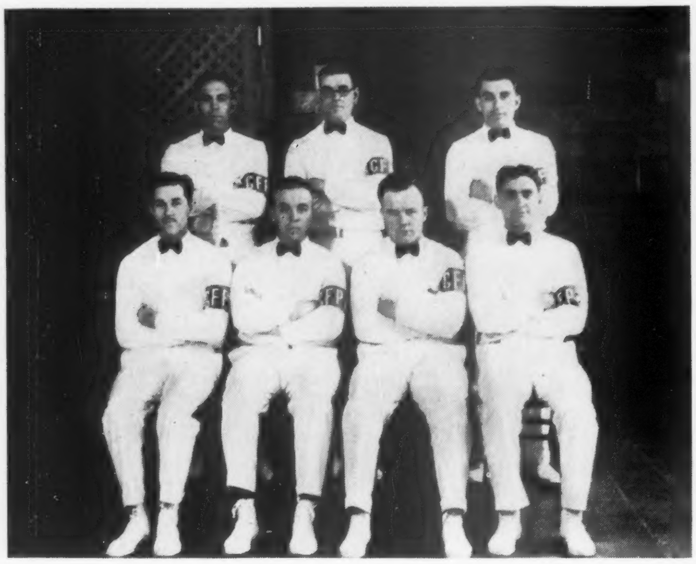
Because of their weight, the handling of heavy objects is usually accomplished by means of cranes, derricks or other rigging, and accidents occurring during this handling process are often very severe and frequently fatal.

Kiln and Cooler Hazards

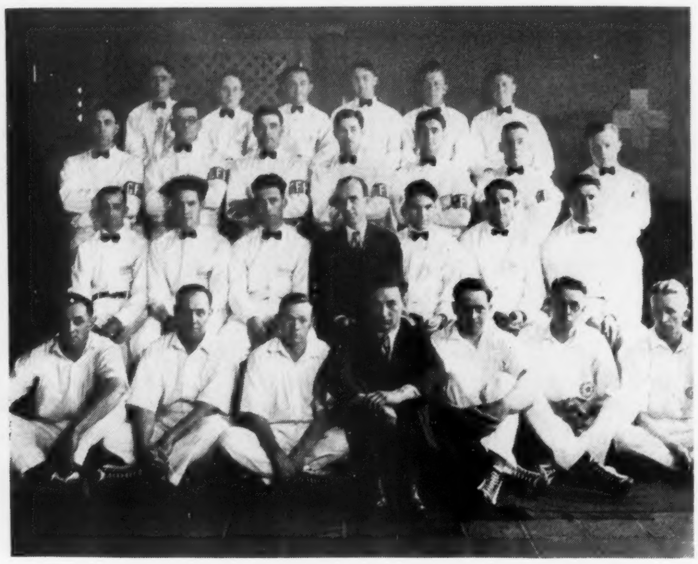
As heat is an important factor in cement manufacture, there are certain definite hazards in the operations around and about kilns, coolers, etc. Handling electricity is a job that may prove a hot one and had better be left to the plant electrician.

Abrasives are common in cement plants, causing a number of injuries to eyes, feet, hands and arms of workers. A common but annoying type of trouble is caused by cement abrading the skin between the

The regional safety meeting of the Portland Cement Association at Albany, N. Y., April 16, 1929



First-aid team of the Glen Falls Portland Cement Co., Glens Falls, N. Y., winner of the first-aid contest at the Albany regional safety meeting



The competing first-aid teams at the Albany regional safety meeting on April 16

fingers of men engaged in bag filling operations, some of these cases resulting in lost time which may spoil a plant safety record. Here is an opportunity for some bright man to devise a completely automatic method of bag filling, releasing the men from the hazards of this work.

There are very few corrosive substances used in regular cement-plant operations, but some of the materials are slippery, requiring care and judgment in handling or stepping on them. This is particularly true of wet places and rubber heels making an excellent skidding combination with the possibility of serious injury, or the handling of heavy material, when wet, slipping through hands, dropping on toes or feet.

Beware Hand Tool Injuries

The use of hand tools is a source of injuries astonishing in the frequency of their occurrence and sometimes amazing in their severity. You are all doubtless aware that handles will break, chisels will chip, bars will slip and shovels do develop sharp edges. The fractures of fingers, arms or legs are not so infrequent as may be imagined; the loss of an eye struck by a flying chip of steel from the mushroomed head of a chisel or drill is a distressing but not uncommon report for us to receive, indicating that goggles should be worn by these men. A dislocation, a serious sprain or bad bruise or laceration are indeed all too frequent occurrences in the use of hand tools.

Avoid Manual Handling

Industrial progress is changing or has changed many operations from manual to part or entirely mechanical process. Where this can be done it: (*a*) Increases production; (*b*) relieves certain men for other work; (*c*) increases safety.

The movement of material in progress through a plant may be divided into three categories: (1) Manual; (2) manual, supplemented by mechanical appliances; (3) mechanical.

Even in large scale production such as we find in cement manufacturing there is still a vast amount of material handled manually, requiring many men for the work and presenting many exposures to injury, unless proper precautions are taken.

Some operations because of their nature and the character of material cannot be changed entirely from a manual operation to a 100% mechanical job, and in such cases we have little, if any, relief from the hazard of straight manual handling.

Don't Walk Under Shovel!

Indeed the presence of moving machinery at the point where men are working may tend to increase the hazard to the workers. An example of this is the power shovel in the quarry, that glutton for work and punishment, with its grinding gears, revolving cab, its swinging bucket, ready to spray rock without fear or favor upon anyone who may be in the path of these donations, and its boom hanging over the heads of workmen like the sword of Damocles, apparently ready to fall. And booms have been known to fall at the most unexpected moments. It is a wise rule to keep your men out from under.

The haulage railroad in quarries is another prolific source of accidental injuries through striking men, rock falling from cars or causing tripping, falling of the men over tracks, ties and switches and in the dumping operations when cars are emptied at the crushers.

In the plant we have our hammer mills, belt conveyors, screw conveyors, ball mills, bucket elevators and so on. Wherever it appears practicable the work of handling material is being done by mechanical means to relieve the workmen of the drudgery and the hazard on the one hand, and on the other to stimulate the flow of material through the plant to satisfy the public demand for the product.

In the design of mechanical apparatus for handling material, the prime object of engineers who pioneered this field was maximum efficiency in production with very little, if any, consideration being given to the safety of those whose work might bring them into contact with such apparatus. As a consequence each worker found that he must watch his step very carefully to avoid injury, but many ghastly accidents have occurred in and on, equipment of this description.

Guards and Modern Design Help

It is not uncommon some years ago, to read accident reports such as "J. Smith, caught in bucket elevator, back, legs, ribs and skull fractured. Death—widow and 5 children." Such cases are not so frequent today, largely because, (1) safeguards have been applied to dangerous moving parts of existing mechanical equipment; (2) new equipment is, of necessity, so designed and constructed that "built-in safety" is one of the outstanding features to which designing engineers and the manufacturer must devote their attention to keep abreast of the safety movement and to make certain of satisfactory performance on the job; (3) education of the worker.

A safety man might well direct his attention to the safeguarding of existing conveyors and elevators where he finds that this has not been thoroughly attended to in a way substantially to safe-

guard the worker against injury.

Many examples and illustrations could be given of improper use of safeguards or failure to restore them when removed for adjustment, repair or otherwise. Careful supervision is required to assure proper mantenance of safeguards; the penalty for neglect in this important item often being a serious injury or death of a worker.

Common Plant Hazards

Sometime ago a man at the quarry end of a long belt conveyor, who had just relieved the hopper tender, had occasion to step down to the belt floor. This belt had been safeguarded with a panel guard but the panel had been removed for some reason by the man going off shift. The man coming on shift took for granted that the panel guard was in place, therefore, no special care was required to avoid the belt; he was caught and crushed to death at the idler pulley.

Screw conveyors should in all cases be well covered and guarded to prevent injuries, which because of the construction and operation of such equipment occasionally have fatal results. This is exemplified in the case of a man who stepped into an uncovered screw conveyor resulting in the loss of a foot and another case of a cover not being properly replaced causing a man to fall through into the revolving screw. Floor plates covering such equipment should be secured with bolts or other devices to prevent displacement.

The stock-house crane, handling vast quantities of rock and other raw materials, is a piece of equipment the operation of which produces perhaps few but certainly some very severe injuries to the workers in this department. Careful inspections should be made at regular intervals of all parts of cranes, to see if strands are badly worn or broken in any of the ropes, and that standing ends are properly set and fastened in thimbles or shackles, that all moving parts are in good condition and that the insulation of electrical conductors is safe throughout.

New York Cement Plant and Quarry Accidents Reviewed

A review of 815 accidents which occurred in cement quarries and plants of New York state in a recent year show out of the total that 385 occurred in the quarries and 430 in the mills and that these accidents are charged to the following operations and items:

QUARRIES

Falls of overburden and other falling objects	44
Handling rock at face	89
Hand tools and timber	31
Explosives	4
Haulage	30
Falls of persons	19
Flying objects	49
Rock drilling	14
Machinery	40
All other	65
Total	385

MILLS

Haulage	29
Machinery	54
Hand tools	40
Nails and splinters	25
Electricity	4
Falls of persons	30
Falling objects	57
Flying objects	64
Burns	28
All other	99
Total	430

An analysis of these data reveals the interesting fact that of the total of 385 injuries in quarries, 199 or 52% of the total are properly chargeable to material handling! Of the total of 430 injuries in the mills there are 161 or 37% in those classifications involving the handling of material!

Handling Is Center of Picture

It is consequently apparent in a very startling degree that here is the center of our accident picture, the focal point of our problem, the control of which would undoubtedly relieve us in large measure of those incidental items of injury causes that have given many a safety man a headache.

Your attention is invited to a quotation from a recent publication of the Bureau of Labor Statistics of the U. S. Department of Labor, after analyzing 838,042 reports of industrial injuries: "The handling of tools and objects give rise to the greatest number of accident shown . . . there being a total of 472,805 cases in these periods."

This indicates that handling of objects and tools accounts for 56.3% of the total of accidents so analyzed from general industry, corresponding closely to our own problem in the cement industry. We would like to make it clear at this point, however, that the above figures used for comparison show the frequency of injuries and should not be considered as a yard stick of severity. Nevertheless accident frequency is the compass by which we must be guided to determine where our greatest number of injuries are being developed, for the purpose of applying proper measures to correct the underlying causes; and cause-determination must be the initial step of any program of accident prevention. Archimedes the Greek said, "Give me a lever and a fulcrum of the right size and I shall move the earth." You safety men may well say "give us the accurate causes of our accidents and we shall develop the means of preventing them."

Education

The prevention of work injuries lies within the ability of your organizations and the successful consummation of this ambition may be realized by the application of definite educational methods.

Perfection in this department of your activities is made up of many trifles but perfection itself is not a trifle. There is no short cut, no patent road nor beaten path which may be easily traveled without effort on your part to reach the goal of assured safety. The way is tortuous; it is slow, it is discouraging at times but your aspirations will be realized through consistent efforts and bull dog perseverance, until the atmosphere of your plant is changed from an attitude of indifference to that of safety in all departments for every man engaged in the operations regardless of their nature.

If this picture appears to you as rather too highly colored, reference need be made only to a recent report submitted by the secretary of your own association wherein he shows a list of 17 cement plants, each of which had operated for periods exceeding one year without suffering a reportable accident to any of the workmen!

Inquiry to the men responsible for these records would undoubtedly evoke a uniform response that they had provided safeguards, where needed, for the mechanical equipment, but that the real solution to their accident problem was found in the development and application of safety educational methods appropriate to the conditions and circumstances prevaling in those plants.

Your alert minds will readily grasp the significance of safety posters and safety slogans, but the question arises as to whether these vehicles of education can be understood by all the men in your departments. Therein lies your great opportunity as foremen, as leaders, not only to train your men to do their work properly, but also to teach them to think along constructive lines; to develop their mental faculties; because after all the foundation of your safety program must be laid in the inherent desire for closer and better human relations. It must be bonded with mutual understanding and co-operation—and—gentlemen, let me point out that from time immemorial there has been nothing in the great human family that so closely binds us together for mutual welfare as the understanding heart and the helping hand.

The Foremen's Responsibility

There is a growing appreciation in the minds of plant foremen that their responsibilities embrace the safety of the men under their supervision, and rightly so, because the foreman is closer to the men than any other executive. They are the points of contact with, and in the final analysis responsible for carrying out the policies of the management, and their success in doing this has a

profound effect upon the workmen. The foreman consequently can make a strong and direct appeal to his men which he will find invaluable in aiding the plant safety program.

Where he finds resistance in the mind of any man to an item of accepted safe practice he can adopt corrective measures and teach him the principles by which he should be guided and the necessity for maintaining an open mind on the important subject of safety to himself and others. (In Italy a form of correction is being applied for certain offenses against the laws. This method has a great awakening effect upon the offenders and leaves them cleaner and better citizens. The prisoner is forced to drink a quart of caster oil!)

The inertia in the minds of some men which is so frequently encountered among industrial employes may be overcome by the farsighted foreman who can awaken an active interest, a mental alertness and the desire for participation in the safety program by illuminating examples and illustrations, visualizing situations and so encouragingly portray the subject that your men will see the light and activity in the right direction will result.

The men who work in our plants are normal every day humans with the same interests, the same desire for the joy of living, the same love of justice and the same love of adventure. It is this adventuring spirit which may be capitalized by your safety men, by capturing the attention of your men in the presentation of the problems and on listing their mental ingenuity in the solution of them.

This spirit will find expression by appealing to the imaginations of your men, by giving them an active part in your program and imparting to them the idea that they are more than a check number in the plant! A man who is duly impressed with his identity as an integral unit of an organization will usually respond in a manner to aid the safety program.

Capitalizing the Venturesome Spirit

The venturesome spirit of some workmen which is sometimes manifested in those actions that give safety men gray hairs and usually characterized as recklessness can be turned to good account by properly and skilfully guiding them into the desired paths, providing them with the manifold opportunities for adventuring in accident prevention, creating an outlet, a medium of expression for those promptings of an active mind and a healthy body that must be occupied every hour of the day. In other words, we discard the unhappy, negative procedure and adopt a positive course replacing discouraging criticism or discilpine with opportunities for constructive effort.

Resourcefulness and resolve are the "gold dust twins" of safety. With their help the plant safety educational program will go far; you may utilize to advantage what has happened to evolve methods of prevention. You see, there are many men in industry who merely believe in safety as a matter of convenience, but apparently never do anything about applying it. They nned an awakening to bring them out of the rut and start them thinking and working to correct the mistakes which too often result in what we call accidents and are the cause of so many personal injuries.

Courage is another attribute which may be utilized in your safety work—the type of courage that enables the plant carpenter or blacksmith to get onto a platform and tell his co-workers "it pays to practice safety and I speak from an experience of 35 years." Your safety work can find no stronger support than that given by one of your own men to his fellows. This requires a high order of courage to overcome the natural difference of the majority of workmen to speak to a body of men assembled at a meeting, but it is certain to make a strong appeal to the common sense of the workers.

A. G. Beck, superintendent, Canada Cement, Ltd., Montreal, who led the round table discussion at the Albany meeting

Enthusiasm in safety work can be created by having the men actively participate in the program in some capacity which will provide an outlet for their ability. We have seen enthusiastic demonstrations at plant safety meetings that proved beyond a doubt that every man present was a 100% safety man and that his enthusiasm in this work would be communicated to the men in his department. This is one of the strongest assets of any plant safety program and a true measure of the morale.

A valuable characteristic in workmen is initiative; that quality of mind that prompts Jim Brown to remove a plank, a pipe or a rope from a passageway to prevent the other fellow stumbling and falling; he reports a broken rail guard, a bad stair tread. In other words, he thinks! He is a self-starter who does not need constant prodding nor to be moved about like a piece of machinery. A machine will work, but a man must think!

Given the opportunity for expression an astonishing amount of talent may be developed in the personnel of your plants for a constant and whole-hearted campaign in the interest of accident prevention. With the development of these factors into a working program supplemented by your bulletin boards, safety posters, slogans, plant organs, safety rallies, contests and awards you can build up a safety spirit which will be an effective protection against work injuries to your men because the workers who are exposed to the hazards become the guardians of their own safety. This is emphasized in the slogan: "The best safety device is just above your ears."

Safety in the handling of material is a goal that can be achieved only by the use of training, analytical thinking and the proper application of educational methods along these lines. Safety is like a cable; we can weave a thread every day, a strand every month, until it is woven into the fabric of our operations, too strong to be broken. A caution here, a suggestion there, a warning, a man prompted, another admonished by his foreman—all these are helpful in cultivating safe-habits among your workers and developing in them a safety consciousness which will be a bulwark against accidents.

In view of the fact that this item embraces about 50% of the accident situation in the manufacture of cement, the necessity for the application of broader safety educational activities is manifest in those plants with a poor accident record in the handling of objects, to overcome in the plant personnel any resistance, inertia or indifference to safety; to employ courage and resourcefulness in developing this work; to encourage initiative and enthusiasm; to promote collective and individual interest and to capitalize this educational work for the benefit of improved human relations. Safety work is a service, the helping hand, reaching from man to man for mutual welfare.

The social advancement among industrial employes in recent years, due to better contacts and environments, the broadening influences of such mediums of entertainment and culture as the motion picture and the radio, is reflected in quicker and readier response to efforts extended for their well being, resulting in greatly improved industrial relations. The liberal conception of the benefits to be derived from this cooperative work accounts for a better understanding of the gospel of accident prevention.

We may well embark upon a campaign of adventuring in safety, employing experience for our captain, caution for our pilot, diligence, perserverance and patience for our crew, sailing under the flag of accident prevention on a voyage to the haven of safety.

Accident Prevention from the Executive Viewpoint*

By J. A. Lehaney
Vice-President, Lone Star Cement Co., Kansas

INDUSTRY is demanding a type of executive; one who not only is familiar with the processes of manufacture, but who also sympathetically visions and understands the problem daily confronting the worker; one who, while directing, creates in those associated with him the liveliest sort of co-operation; one whose qualities of judicial fairness and human sympathy develops and holds the confidence of his men. He is concerned in safeguarding them in their employment no less by reason of their economic value, impaired as it may be from lost time, than by a humanitarian interest in their welfare.

Is the time and money required to promote accident prevention economically justifiable? There is abundant proof that the answer to this query is in the affirmative, in the experiences of our largest industries. An industry which tolerates unsafe conditions is an agent of inefficiency. Safety and efficiency are closely linked together. It is generally found that efficient production and distribution go hand in hand with safe working conditions. Those working conditions under which the employe does his best work are also the safest conditions. It has been demonstrated that insurance costs, however carried, have been lowered by giving due attention to accident prevention. There is such an intimate relationship between safety and production that it is well-nigh impossible to increase in productivity without reducing the accident rates.

It is obvious that a clean, neat and safe plant in which the employes contentedly work, under conditions as pleasant as the circumstances of the work may permit, will necessarily be more efficient and a greater producer than one of which the opposite is true.

Hidden Cost of Accidents

The Travellers' Insurance Co. analyzed 5000 specific accident reports, taken at random from their records, which disclosed that the hidden cost of accidents is four times the direct or insurable cost. In this item of hidden costs such factors were considered, weighed and estimated as lost time of the injured employe, time lost by other employes whose work is interrupted out of curiosity or sympathy to render assistance, time lost by foremen and superintendents in assisting the injured one, preparing accident report, injury to machinery or property as result

J. A. Lehaney

of the accident, the less-effective work of the man replacing the one injured and numerous other factors. It is reasonable to believe that intelligent and organized effort to prevent accidents results in lower insurance costs, even greater reduction in the hidden cost, and increased plant efficiency due, in part, to the improved morale of the worker.

But for such endeavor there is yet another reason, either stronger or weaker, dependent on one's ethical conceptions, and that is the obligation resting on each of us to do his part to prevent needless suffering and privation.

The object of all intelligent management is to develop conditions whereby all labor has the proper attitude toward its job. The development of such an attitude is the responsibility of intelligent management. Competition has made it necessary for industry to conduct a war against waste resulting from accidents. The trained executive knows that he must keep labor reasonably happy if he would avoid the destructive forces of labor turnover.

Advantages of Regional Safety Meetings

The report of the Portland Cement Association for 1928 showed that 18 mills completed the calendar year with perfect accident prevention records. Looking back over a period of five years we find that in 1924, 1 mill; in 1925, 2 mills; in 1926, 2 mills, and in 1927, 10 mills, had a perfect safety record. This tremendous improvement from year to year shows what organization and education can accomplish.

Much of the success of the Portland Cement Association's committee on accident prevention is to be attributed to the program of Regional Safety Meetings, such as the one we are participating in at this time. Twelve such meetings were held in 1928. They were attended by representatives of 125 mills. I understand the work for 1929 has been expanded to provide for additional regional meetings, and that June will witness the greatest co-operative undertaking ever attempted by member cement mills and quarries—the production of a big month's quota of cement without an injury to any employe. Co-incidentally, the cement mills with the Bureau of Mines participating will embark on their first annual community safety drive, the purpose of which will be to carry safety instructions to industrial and residential districts in the vicinity of the various mills.

The safety trophy award of the Portland Cement Association is the highest honor bestowed by the industry for any achievement. The award of the trophy has not only helped the companies to reduce accidents, but has also produced a large amount of community good will and publicity helpful to public relations.

I will say here that our company was one of those awarded a safety trophy for a perfect accident record in the year 1927. This trophy was dedicated, with appropriate ceremonies, in June, 1928. It is located where every man going to and from the mill has occasion to pass this constant reminder of safety at least twice daily. That it has served as an inspiration is demonstrated by the fact that we experienced but one lost-time accident in 1928. We are striving for a perfect record this year, with excellent prospects.

Real Co-operation

The success of the movement having to do with the prevention of accidents and the saving of life and limb has been brought about through the fullest measure of co-operation on the part of the rank and file and the executives of the cement industry. Organized safety work is now carried on by practically all the manufacturers. The excellent record already mentioned of the results achieved show in no unmistakable terms what this organized work has accomplished.

One of the best ways to make an employe a keen supporter of safety is to assign him responsibility for the promotion of the safety movement. The personal contact with actual problems that he will get while a member of the safety committee of his plant or department, together with the constructive guidance that the management provides such com-

*Paper delivered at Kansas City Safety Meeting of the Portland Cement Association.

mittees, will cause him to become an active booster for safety and co-operation at all times.

The plan of having safety committees made up of workers from various sections of the plant is one of the most effective methods in use. Members of these committees should receive constant guidance and instruction in the underlying principles of safe practices and methods. Membership should be rotated through the entire personnel, so that as many different workers as possible will have the opportunity of sometime serving on the safety committee.

It is said that the annual economic loss to employers alone, because of industrial accidents is ten billion dollars. It is the duty of us in the cement industry to salvage as much of this loss as possible.

Handling Our Own Accident Prevention Work

If I may refer to our own operation: The experience of the Lone Star mill at Bonner Springs has been quite gratifying in the number of the reductions in accidents and in the lessening of the turn-over. This has been brought about by the employment of several factors: *First*—the company carrying group insurance which covers the entire personnel. *Second*—the paying of cash bonuses as a reward to departments for having no lost time accidents throughout the calendar year. *Third*—providing entertainment for the men and their families as well as members of the community semi-annually. These are "get-together" affairs, serving as a means for the men and their families to become better acquainted with each other as well as with people in the community. In that way the families and the community become interested in and lend help to the safety work. Every opportunity is taken advantage of to exhort the men to carry the safety work to their homes and to the community. *Fourth*—medical supervision provided by the company, the doctor visiting the plant at a regular hour daily.

Education is carried on through plant Safety Committee meetings; the display of safety posters throughout the mill and quarry; a wide distribution of the association accident prevention magazine, also publications of the National Safety Council.

General safety meetings, which practically all the men attend, are held monthly. Quite frequently an outside speaker interested in safety is secured from whom we gain new ideas on how to prevent accidents. One of our executives is usually present at these meetings. We have found the safety committee and the monthly safety meetings excellent mediums of contact for developing acquaintanceship and promoting that understanding and good-will so much to be desired between mill employes and the officers.

Safe Handling of Explosives*

By R. H. Summer
Technical Representative, E. I. du Pont de Nemours & Co.

I AM reminded that my first investigation of an accident, in 1918, was in Texas, and was one that cost the lives of six men. Another serious accident on which I was called for investigation in conjunction with a Bureau of Mines representative was in 1924. This accident killed eight men. Both were due to accidental discharge of explosives while loading well-drill holes.

In discussing the subject I have decided to keep away from the many rules and regulations governing the safe use of explosives. The Bible gives us ten commandments. The manufacturers of explosives print 49 official "Don'ts" and a dozen or 15 other "Don'ts" that every superintendent or foreman in charge of explosives should know.

R. H. Summer

Safe handling of explosives comes under three general divisions. These are the manufacture, transportation and use of explosives by the consumer. It is in the latter that quarry men are most interested. However, I think we might take a little safety trip through the process of manufacture at a dynamite plant, the packing and transportation of dynamite and then to your quarry, where I will talk to you as I would if we were sitting on a powder box waiting for a shot. Please note I said powder box and not a box of powder.

Time will not permit a detailed description of these, so I will touch only a few high spots from a safety viewpoint in order to impress upon you the care with which explosives are handled prior to reaching your operations, and that this care has produced tangible results.

Upon entering a dynamite plant we are met at the gate, where all matches are surrendered. A little further on we are fitted to rubbers as a precaution against contact of shoe nails, grit and explosive material. We first go through the safety zone where all raw materials not themselves explosive are prepared. These materials are inspected, analyzed, screened and weighed before going to the mixing plant.

Safety in a Nitro-Glycerine Plant

Now we go over to the nitro-glycerine house. Here practically everything is rubber or wood. Containers for weighing the nitro-glycerine are of rubber, the scales are covered with rubber. The floor is white enamel with rubber strips where workmen walk. This enables the workmen to readily detect any spots of nitro-glycerine on the floor. The nitro-glycerine is drawn off through rubber hose into a rubber tired buggy arrangement called by some workmen the "angel buggy."

In this conveyance the nitro-glycerine is transported to the mixing house where it is introduced into the mixing bowl through a rubber hose. The mixer is all wood and rubber and no metal is allowed to come in contact with this mix which is now dynamite.

From here on through the process of cartridging, packing into boxes, transporting and until safely and efficiently shot in your quarry, explosives constitute a hazard. The cartridges are packed by carefully constructed machinery. The plungers that pack the dynamite into shells are rubber tipped. The packing and transporting of explosives are done in compliance with the rules of the Interstate Commerce Commission, and this is designated by the I.C.C. 14 or 15 that you see on boxes of explosives.

By now you are probably impressed with these safety precautions, where all rules are rigidly enforced and discipline is perfect and permanent.

Twenty years ago explosives manufacture took its share of life. Today statistics show a most remarkable safety record in reduction of lost time and fatal accidents. One dynamite plant completed three years without a lost time accident. So impressive has safety work in explosives plants been that I want to give you an example of how you and I benefit by this work. Please pardon reference to myself and my company. When

*Paper presented at regional safety meeting of Portland Cement Association, Dallas, Texas, February 14, 1929.

I first started in the explosives business it was almost impossible for anyone handling dynamite or explosives to get any life insurance and was, I believe, impossible for workmen in plants to secure any form of insurance. Particularly you young men with families know that this is not a pleasant predicament to be in. A few years ago a large insurance company made a study of accident record statistics of our company and as a result this company will now issue any form of life insurance to any employe at regular rates. Think what this means to many who have little other opportunity of creating an estate; and certainly it is the direct result of cooperative safety work of workmen and officials, and moreover indicates what can be accomplished in safely handling a hazardous material.

Now just briefly to give you an idea of what has been done by explosive manufacturers, cooperating with the railroads and Interstate Commerce Commission toward safe transportation of explosives. In 1907, the first year of statistical records, 79 accidents in transportation of explosives on railroads in the United States and Canada. Fifty-two were killed and 80 injured and a property damage of some $600,000 resulted. In 1927 (I have no figures for 1928), the Bureau of Mines reported that about one-half billion pounds of dangerous explosives were transported in the United States and Canada without injury or loss of life and properly damage of I think $43 and this was due to fireworks.

This is another bit of evidence that safety pays and that real results are evident.

Proper Methods of Handling Explosives in the Quarry

Now we are out at your quarry and I am going to start in with the arrival of a carload of dynamite. What kind of magazine do you store this in and what has this to do with safety or preventing accidents? Just this—improper storage causes deterioration of explosives and deteriorated dynamite causes misfires and misfires are one of the most prolific sources of explosive accidents. Just a little leak in the roof of an otherwise good magazine may spoil a few cartridges of dynamite; one of these cartridges may contain the primer. A misfire results possibly unnoticed. Then the jackhammer man drills the hard bottom and perhaps into the unexploded dynamite. This has happened; the result is usually serious and the cause goes right back to improper storage of dynamite. I am stressing this point because I have seen some very efficient quarry superintendents and cranks on safety permit their stock of dynamite to be stored under very improper conditions.

And now about the shot or the act of using explosives in your quarry. One man should have complete supervision of all shots and whoever this man is he should be thoroughly familiar with all the "Don'ts" of explosives practice, and this is not enough. He must be capable of foreseeing and anticipating possible accidents due to local conditions or changes in local practice which may bring in a previously absent hazard. For instance, the electrification of quarry equipment is introducing new hazards, especially the electric well-drills and electric stripping shovels. These operate on top of the bench where shots are loaded and sometimes they are operated at the same time. This introduces the possibility of stray currents; they do exist and we must be on the lookout for them.

I am not going to burden you here with detail rules and regulations regarding explosives, caps, electric caps and fuse. However, every man in charge of blasting should be familiar with these fundamental rules and should rigidly enforce them on his blasting crew. One violation may cause an accident and unfortunately others than the violator of the rule are caught in the accident. Manufacturers of explosives have these rules in their pamphlets and also in poster form. These are supplied on request.

Another function of the superintendent or foreman is his attention to the human side of the blasting crew from a safe standpoint. Men for blasting crews should be picked with reference to their attitude toward safety. In my own work I observe three types of workmen on blasting crews. First, the careful man who knows what to do and what not to do. If you have this type of man on your crew you should be thankful. His care may mean much to you, so keep him there. Second, is the ignorant man. He is usually cautious through lack of knowledge of the characteristics of explosives. This type of man should be educated, but preferably before he gets on the crew. Explosives are like the courts in that they do not excuse ignorance of the law, and if an accident happens because of ignorance the damaging results are not mitigated in the least. The third type is the careless, bravado type of man. He is a dangerous man on the blasting crew and should be removed. If permitted to remain he reduces the morale of the whole crew and is always particularly anxious to demonstrate his knowledge of explosives to new men in showing them that it won't go off. I have criticised this type of workmen for dangerous practice and gotten such answers as "Boy, I was shooting dynamite before you were born," or "I've been doing this for so many years." They always add that "it never went off." A good way to answer this is, "Is that a fact it never went off? Did you ever talk to one who said he did what you are doing and it did go off?" No, unfortunately he is not here to tell about it.

Canada Gypsum Buys Five Producing Companies

THE Canada Gypsum and Alabastine Co. has bought the Beachville Lime and Stone Co., the Chrissie Henderson Co., the D. Robertson Lime Co., the Toronto Lime Co., and the Wellington Lime Co. The purchased firms are all located in the province of Ontario. These deals are said to make the Canada Gypsum company the largest producer of gypsum products in the Dominion. —*New York* (N. Y.) *Wall Street Journal.*

New Cement Plant Projected in San Francisco District

THE PORT STOCKTON CEMENT CO., formed under Nevada laws six months ago to operate a cement company in California, has applied to the state corporation commission for permission to issue 30,000 shares of preferred no par stock with dividends set at $2 per annum, 1,000,000 shares class A voting and 50,000 shares class B voting, both of no par. The last named class of stock will carry 20 votes per share and the 1,000,000 shares of class A will be entitled to one vote per share.

The company owns 800 acres of limestone deposits at Columbia, north of Sonora in Tuolumne county. Properties are cut through by Stanislaus river, exposing limestone on three sides reported to depth of 1000 ft. The quarry operation, to cost $700,000, will be started at Columbia within 30 days. The mill, to cost $2,250,000, will be constructed at Stockton and work begun in 60 days. Lime rock will be brought to the mill on specially constructed combination barges which will also deliver the product to all water points. The company plans to effect savings by shipping oil for quarry use in barges on return trip from Stockton. Officials of the new company told Dow Jones and Co. that they expect to deliver cement into San Francisco bay area 30c. per barrel cheaper than any cement company now lays it down.

Private underwriting of the company's stock has been effected. It is not expected to be offered to the public until after construction work on mill and quarry is under way. The new company has been organized by a group of Nevada and California capitalists and engineers, among the latter being W. C. Stevenson, formerly chief engineer for Pacific Portland Cement Co., Yosemite Portland Cement Co., and Pacific Coast Cement Co.; A. E. Roberts, formerly with Old Mission Portland Cement Co.; F. B. Hyder, formerly with Daniel C. Jacklin Copper Co., and Louis Everett, who will be chief geologist. These men are directors, and officers will be selected soon from among California executives. They will be designated by the banking group financing the enterprise.

Robert Lee Dunne, one of the organizers of the company, was formerly connected with senior financing of Carquinez, Antioch and San Francisco Bay toll bridges. The Port Stockton Cement Co. owns 90 acres of clay directly opposite the site of the proposed Stockton plant which will be liquified and pumped to the mill.—*Oakland* (Calif.) *Tribune.*

Foreign Abstracts and Patent Review

Determination of Silicic Acid in Portland Cement Pulverized Raw Material by Aid of Ultrafiltration—According to H. Mindermann, synthetic cements are coming increasingly into use, these being cements in which not only the proportion of lime reaches a certain figure, but also the other important hydraulic factors SiO_2, Al_2O_3 and Fe_2O_3. Such cements contain therefore very definite figures of relation (hydraulic relation = $CaO : SiO_2 + R_2O_3$; silicate relation = $SiO_2 : R_2O_3$; iron relation = $Al_2O_3 : Fe_2O_3$), made necessary to obtain earlier strength or higher strength cements. The silicate and iron relations become as important as the hydraulic relation and make necessary the use of further raw components such as bauxite and iron ore residues, depending on the chemical composition of the raw limestone and marl or clay. Essential in weighing up the raw components is in every case the exact knowledge of their chemical composition aand the calculation of an accurate synthesis, and all hydraulic factors should be known continuously for securing a best quality product. The determination of the quantity of lime can be done in a relatively simple manner, accuately, and in very short time in various known ways. But the determination of the other factors, first of all that of silicic acid (SiO_2) requires considerable time, according to present methods. Recently, however, there appeared two articles by Hart on determining silicic acid by aid of membrane filters (*Zement,* 1927, No. 13) and by aid of ultrafiltration in silicates to be converted or decomposed (*Zement,* 1927, No. 32), which methods offer a very desirable change in the analytical operating method employed thus far. But the second method of Hart, for investigating the raw flour for portland cement, is of primary interest here because in most cases this mix consists predominantly of silicates to be converted.

In Hart's ultrafiltration method, 1 gram of the raw flour is decomposed in a platinum crucible with four to six times its quantity of sodium-potassium-carbonate, as customary. The clinkered cake is removed quantitatively from the crucible and the smelt dissolved as far as possible with hot distilled water in a porcelain dish and disintegrated with a small excess of hydochloric acid. It is then evaporated until the silicic acid gel has formed, yet the crystallizing out of the salts has not yet started. If larger lumps have been formed, they should be crushed with a glass rod. The substance is then cooled in this condition. It is then dissolved with 10 to 20 c.c. of distilled water, being stirred well and then 10 to 20 c.c. of alcohol added. The liquid is then heated considerably upon the wire net, under continual stirring, for three to five minutes. It is then thinned with distilled water and filtered through a Cella filter, then washed out with hot distilled water to which alcohol is finally added. This method proved unsuitable in the cement plant laboratory because, though saving in time, it did not comply with the expected results, and there was a certain insecurity in the accuracy of the results; in no case was the formation of silicic acid gel observable as when evaporating cement samples dissolved in hydrochloric acid, though there occurred a flaking out of silicic acid after the solution had stood for some time in water; but in a further evaporating the crystals appeared without the formation of a gel. Since this condition was related to an excess of crystalloid substance in the sodium-potassium-carbonate decomposition it was attempted to decrease this substance to a minimum. Accordingly, 1 gram of raw flour was treated in a cup glass with a little thinned hydrochloric acid, boiled and filtered, the washed-out residue slightly glowed in the platinum crucible and weighed. Sodium postassium-carbonate was now added at five times its weight (about 1 gram) and decomposed. The decomposition was then dissolved in the already somewhat evaporated filtrate and then further evaporated in the water bath under continual observance. The results were negative again, for there was no formation of gel, no flaking out of silicic acid, but immediate crystallization. Yet determinations of silicic acid, according to Hart's method, were made with two fundamentally different cements.

Other methods of decomposition were then investigated to make the ultrafiltration method useful for determining silicic acid in raw cement flour; $CaCO_3$ respective CaO being tried first in place of sodium-potassium-carbonate since, used in small quantities, it can, at suitable temperatures, decompose silicic acid completely. And in the technical burning of portland cement the SiO_2 is almost completely decomposed. If by a suitable operating method the SiO_2 can be decomposed completely with the natural $CaCO_3$, respective CaO content of the raw flour in the laboratory by use of small quantities of raw flour, the first method of Hart can be applied. The results of determining the substance insoluble in HCl for the two different cements were tabulated, the temperature required beging 1300 deg. C. (2372 deg. F.). At this temperature, after glowing 20 minutes, there was 0.04% insoluble in HCl, 0.02% residue after evaporating and 0.02% SiO_2 insoluable in HCl, all based on the substance being glowed, whereby the clinker had been sintered in an electrical resistance kiln. The results were in no way entirely satisfactory due to excessive time and uncertainty of results involved.

In order to obtain a dependable quick and complete decomposition, a temperature somewhat higher than 1300 deg. C. was necessary. Accordingly, the raw mix (about 15 to 20 gram) is well moistened with distilled water (25 to 26% H_2O) and kneaded. Small bars of raw mix are now shaped with the device shown in Fig. 1, the damp mix being pressed

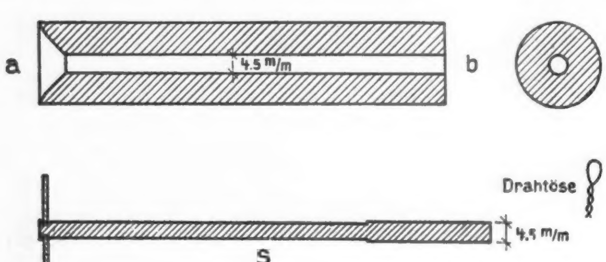


Fig. 1. Device used for shaping small bars of the raw mix

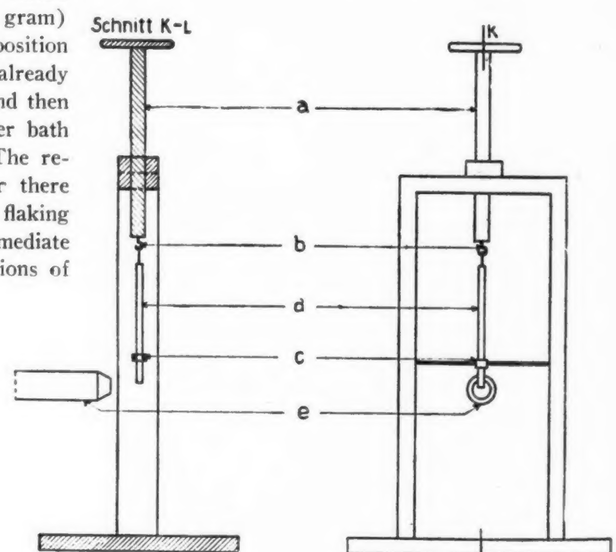
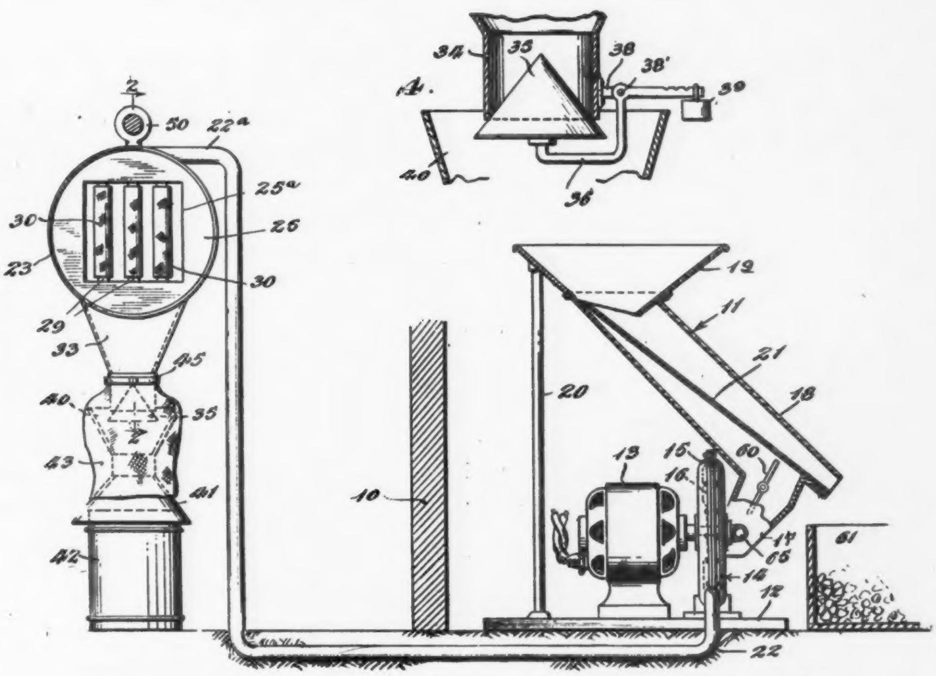


Fig. 2. Apparatus used to heat bars to the point of decomposition

in at the end *a* of the tube by aid of the thumbs. After the tube is filled, it is pressed upon a plate in vertical position with the end *b* upon the plate, and by means of the stamp *S* a slight pressure is exerted upon the mix from the end *a* in order to press it solid. At the end *b* a small wire loop as shown is now pressed into the raw mix, the tube is placed horizontally and then from the end *a* the bar of mix is pressed with the stamp *S* on to a horizontal iron plate, whereby the bar used remains entirely straight. The iron plate is now heated from below, the temperature being increased to 500 deg. C. (932 deg. F.) inside three to five minutes. To heat the bars to a higher temperature, that is, to the point of decomposition, the apparatus shown in Fig. 2 is employed. The bar *d* having been heated on the iron plate is carefully suspended from the hook *b* by aid of tweezers, then the spindle *a* is turned down until the bar *d* of raw mix projects about 1 cm. from the guiding ring *c*. Now the horizontally placed gas-oxygen blower *e* is lit and the bar moved vertically through the flame by turning the spindle. The bar is thus clinkered to a balance of 1.5 cm. Eye shades of blue cobalt glass should be worn. A yellow color indicates that the clinkering or decomposition period has been too short; that is, the spindle has been turned too rapidly, indicating also that then the absolute solubility in HCl does not appear unconditionally. In a number of such tests the insoluble in HCl was a maximum of 0.05% of the raw mix glowed, and as a rule it was 0.01 to 0.03%. The clinker is broken and then sized in a small diamond mortar (small steel mortar) and finely rubbed in an agate rubbing pan to a point where everything passes through a screen of 4900-mesh per sq. cm. (175 mesh per sq. in.). About 1.10 to 1.20 gram of substance is thus obtained, of which 1 gram is weighed in for an accurate analysis. Then the Hart method for determination of silicic acid by aid of membrane filters is employed. Accordingly, in a cup glass of 150 c.c. 1 gram of cement is made into a paste with 1 c.c. of H_2O, and this is disintegrated with 3 to 5 c.c. of hydrochloric acid of 1.19 specific weight and stirred well. The resulting gel is brought above a warm sand bath or above the lighting flame of a Bunsen burner in order still to transfer the traces of brine silicic acid into the state of gel. The gel may then be cooled. It is then thinned with water to 100 c.c. and stirred lively to size the lumps of gel, then filtered and then washed out well with a hot diluted hydrochloric acid and rewashed well with hot water. If the filtrate is now divided into two halves, R_2O_3 and CaO as well as Fe_2O_3 may be determined within short periods, and the three relations figured from it most accurately. After sufficient practice the process could be done in about 40 minutes, after which the ultrafine filtering with the porcelain funnel apparatus required 40 to 50 minutes, 50 c.c. of cold water being added in place of the 100 c.c. suggested by Hart. After about 2½ hours the CaO is weighed out. Meanwhile were also determined raw SiO_2, fumed off SiO_2, R_2O_3 (precipitated twice) and Fe_2O_3 titrimetrically with potassium permanganate, according to Zimmermann-Reinhardt. The three relations can now be figured irrespective of MgO and SO_3. And soon one can correct possible faulty relations by corresponding changes in weight. The method has proven itself completely for the practical control of raw flour in the manufacture of synthetic early high strength (high grade) portland cement. A practiced analyst can easily complete three determinations of raw flour inside 10 hours, and one ultrafine filter suffices for 10 filtrations of silicic acid.—*Zement* (1929), **18, 5**, pp. 124-128.



Dust separator and collector which employs the centrifugal principle

Manner of Storage of Standard Cement Specimens and Their Behavior as to Strength—Joseph Keith presents the figures he collected upon the basis of the type of storage of standard test specimens by M. Gensbaur of Kladno and termed Kl-storage (or K-storage), which is 28 days of combined storage followed by 28 days of storage in water. He added more than 28 references to articles on Kl-storage. He tested high grade portland cements and ordinary portland cements of various countries, a fused cement and a bauxite cement, restates Gensbaur's conclusions, and presents six tables of test results on the 18 cements under normal combined storage and water storage of different periods up to 112 days, which were started in November, 1927. Since further research is being done, the conclusions are not to be considered final. The alternate storage in water, air, again in water, again in air, results in specially high strengths; and if water storage follows upon combined storage, the strengths decrease, especially the tensile strength.—*Zement* (1929), **18, 4**, pp. 94-97.

Contribution to the Knowledge of Old Mortars—K. Biehl presents the results of analyses of six different samples of old Roman mortars of the years 100 to 400 A. D. and of a German mortar of the year 1760.—*Tonindustrie-Zeitung* (1929) **53**, 22, pp. 449-51.

Recent Process Patents

The following brief abstracts are of current process patents issued by the U. S. Patent Office, Washington, D. C. Complete copies may be obtained by sending 10c to the Superintendent of Documents, Government Printing Office, Washington, for each patent desired.

Dust Separator and Collector—A recently patented device employs centrifugal separation (as in a cyclone, except that the cylinder is horizontal) in combination with air filtration. If any coarse pieces are to be handled the feed is first passed over a screen to permit only the finer particles to pass to the fan. The fan puts these into the top of a horizontal cylinder with a hopper at the bottom into which the heavier pieces fall. The air carrying the lighter dust is circulated through air filters which remove the dust, allowing only clean air to pass out. The dust collecting on the filters falls into the hopper and the discharge from the hopper is through a valve held closed by a weight, opened only when enough dust has collected to overbalance the weight. This keeps the cylinder sealed all the time. In the form shown there is a tube of filter cloth between the discharge and the dust receptacle below to prevent the escape of any dust as the hopper is discharged.—*C. G. Webster.* January 1, 1929. U. S. Patent No. 1,697,743.

Two Patents Issued for Process of Making High Early Strength Portland Cement

International Cement Corporation's Patents Presumably Covering Process of Making "Incor" Cement

TWO APPLICATIONS for patents covering a process of making high early strength portland cement filed by Harvey Randolph Durbin, chief chemist, International Cement Corp., New York City, in 1926 and 1927, have recently been granted No. 1,700,032 and No. 1,700,033. Extracts from the patent descriptions follow:

According to this invention portland cement made in accordance with known methods is re-calcined to incipient fusion with additional free lime in quantities sufficient to substantially theoretically saturate the silica, alumina and iron therewith. Naturally somewhat less than that quantity of free lime necessary to theoretically saturate the silica, alumina and iron may be added to portland cement clinker and the whole ground and burned to incipient fusion, but excess lime is detrimental and should be avoided. However, if a portland cement clinker is found to possess a substantial quantity of free lime, such clinker can be ground and re-burned in accordance with this invention to produce a good clinker without the addition of more lime being strictly necessary. Obviously more lime can be incorporated into such a clinker also, provided an excess of lime over theory is avoided.

It is generally considered that the principal components of portland cement are tricalcium aluminate ($3CaO \cdot Al_2O_3$), tricalcium silicate ($3CaO \cdot SiO_2$) and beta dicalcium silicate ($2CaO \cdot SiO_2$). The minor components usually comprise magnesium oxide (MgO) and tricalcium ferrite ($3CaO \cdot Fe_2O_3$), whilst gypsum ($CaSO_4 \cdot 2H_2O$) is often present as an added constituent, and small quantities of carbon dioxide, alkalies, silica and water may occur.

The components possessing cementing qualities are the tri- and di- calcium silicates, although it is very probable that tricalcium aluminate and tricalcium ferrite possess cementing qualities to a small degree at any rate. Tricalcium silicate alone displays all the desirable characteristics of true portland cement. Its hydrations proceed in an orderly manner and the addition of a retarder to control its reactions is usually unnecessary.

Dicalcium silicate, on the other hand, hydrates slowly and develops but little strength until after the lapse of several weeks.

The presence, therefore, of lower silicates of calcium tends to detract from the cementing qualities of the resulting portland cement, and similarly it is desirable for the aluminates and ferrites to be in the highest form.

The ratio of combined silica (SiO_2) to combined lime (CaO) in the cement is known as the lime-silica index or factor. In the case of a cement comprising tricalcium silicate only the lime-silica index is 2.8. This is the highest form theoretically attainable but heretofore it has been impossible to produce a volume constant cement having a lime silica index of this value. Owing to the hitherto inevitable presence of the lower calcium silicates the index value has been less than 2.8 and consequently the resulting cement of less value than that desired. The presence of free lime is, of course, detrimental, and in considering the quality of a cement with reference to the lime-silica index only the thoroughness with which the lime-silica combinations have been perfected are taken into account.

Portland cement is the product obtained by finely pulverizing clinker produced by calcining to incipient fusion, an intimate and properly proportioned mixture of argillaceous and calcareous materials, and throughout the specifications the expression "normal portland cement clinker" is defined according to the above definition, taking into consideration the fact that heretofore normal portland cement clinker comprises lower forms of lime-silica, lime alumina and lime-ferrite.

Limits of the Invention

Whilst the above discussion has endeavored to show theoretical reasons for the lack of consistency and slow hardening properties of present-day portland cement, it must not be assumed that the invention is limited on that account to the improvement of portland cement in order to attain what appeared to be desirable results from theoretical considerations which at present are considered to be in order. It may be that the theoretical discussion of portland cement as at present accepted is false, and in view of this the present invention must not be limited to within present-day construction put upon the actions and reactions which take place in the production of high grade portland cement.

In accordance with the above theoretical considerations the object of the present invention is to produce a cement which comprises the highest forms of lime-silica, lime-alumina and lime ferrite, and this invention is based upon the observation that if normal portland cement clinker containing lower forms of lime-silica, lime-alumina and lime-ferrite is treated with more calcium carbonate or calcium hydrate, or calcium oxide or a mixture of two or more of these latter compounds and then burned to a clinker, the resulting product is a cement of exceptionally high strength and volume-constant.

This statement is further amplified in the later patent as follows—Editor: This invention is based upon the observation that if in the manufacture of normal portland cement clinker, more than the usual amount of calcium carbonate or calcium hydrate, or calcium oxide, or a mixture of two or more of these compounds, is incorporated and burnt to a clinker, permitted to cool and the resulting clinker subjected to a further burning operation, the resulting product is a cement of exceptionally high strength and is, moreover, volume constant.

The improved portland cement may therefore be produced by initially admixing more than the normal amount of carbonate of lime or the like with the usual parent constituents employed in the manufacture of cement, and after burning to the usual portland cement clinker to permit the same to cool, grind, and then reheat without the addition of more carbonate of lime or the like being strictly necessary in order to obtain a complete saturation of the silica, alumina and ferrite compounds. It is therefore apparent that the present invention may be applied to the production of a high grade portland cement clinker in such cases where a batch of normal cement has been inadvertently produced and contains an apparent excess of lime so as to render the batch of little or no use. It is obvious that this batch may be retreated in accordance with the present invention so as to result in a high grade cement. This latter application of the present process will be readily appreciated as constituting a valuable eliminator of waste, and as a means of reducing the possibility of spoilt batches to a minimum. Alternatively the process according to the present invention may be slightly modified so that while more than the normal amount of lime or the like is initially incorporated, after the first incipient fusion, more lime or the like is added and the whole subjected to the second heating operation. It must, of course, be understood that an excess of lime in the final product is detrimental and therefore the present invention is limited to

the presence of only sufficient lime to produce the highest grade of cement.

It is impossible to produce such a volume-constant cement by a single burning operation, and the fusion of cement rocks and the like prior to the addition of lime does not effect the desired result. The amount of lime or the like to be added to the normal cement clinker may be computed by analysis of the clinker and subsequent estimation of the requisite quantity of lime needed to produce the highest forms of silicate, aluminate and ferrite.

The initial cement clinker formed by the first fusion is advantageously ground to a sufficient fineness so as to ensure intimate contact with the added lime or the like if this latter addition is necessary. The lime may be admixed with the clinker in a dry pulverized state or may be sprayed in any suitable manner as milk of lime or chalk paste.

The burning operation is carried out in the manner usually employed for the burning of normal portland cement clinker. The clinker resulting from the process according to the present invention is ground into cement and is found to be of exceptionally high tensile strength. If necessary, the burning operation with additional lime or the like may be repeated until the desired product is obtained.

In order that this invention may be clearly understood and readily carried into effect, the following data are given by way of examples:

Normal portland cement clinker is admixed with 15% of carbonate of lime or sufficient to saturate the silica, alumina and iron, the whole being then ground and burnt to a clinker when a retarder such as gypsum may be added if necessary or desirable, and the product ground to cement. If the silica, alumina and iron oxide are not thoroughly satisfied in their affinity for lime the process is repeated.

The clinker used and the cement produced by this process are as follows:

	Knicker-bocker clinker	Knicker-bocker cement	Durbin cement
Silica	23.46	22.36	20.58
Alumina	5.49	5.64	5.15
Iron oxide	2.89	2.66	3.51
Lime	64.55	63.53	65.31
Magnesia	3.13	3.14	3.18
Sulphuric anhydrid	0.12	1.72	1.51

TENSILE STRENGTH LB. PER SQ. IN.

1 day 1-3 sand	87	172
2 days 1-3 sand	87	226
3 days 1-3 sand	187	335
7 days 1-3 sand	308	428

	Houston clinker	Houston cement	Durbin cement
Silica	24.60	23.56	21.70
Alumina	5.60	5.94	6.26
Iron oxide	2.72	2.46	2.70
Lime	66.30	63.90	66.20
Magnesia	0.83	0.84	0.86
Sulphuric anhydrid	0.13	2.03	1.33

TENSILE STRENGTH

1 day 1-3 sand	107	242
2 days 1-3 sand	......	316
3 days 1-3 sand	187	......
7 days 1-3 sand	267	400

The resulting product is a high testing volume constant portland cement clinker, and it has been found in practice that the tensile strength in pounds per square inch is in excess of 300 lb. after a 24 hours' test with a 1 to 3 sand mixture. It is obvious that this is considerably higher than the usual tensile strength exhibited with known cements, these latter only attaining a tensile strength of about 300 lb. per sq. in. after standing seven days.

It must be understood that the term "lime" employed throughout the claims includes all compounds which produce lime on heating.

What is claimed in Patent No.1,700,032 is:

(1) The process for the production of an improved cement, which comprises mixing a portland cement clinker containing a large proportion of tricalcium silicate and incompletely lime-saturated silicate, with substantially sufficient lime to complete the saturation of the incompletely saturated silicate in said clinker, burning the whole to a clinker and afterwards grinding said clinker to cement.

(2) An improved process for the production of high grade cement which consists in intimately admixing a portland cement clinker comprising a large proportion of tricalcium silicate and silicious compounds unsaturated with calcium, with lime in amounts not more than the necessary to complete the saturation of the silica therewith, burning the whole to a clinker and grinding said clinker to cement.

(3) An improved process for the production of high grade cement which consists in intimately admixing a portland cement clinker comprising a large proportion of tricalcium silicate and silicious compounds not completely saturated with calcium, by grinding said clinker with lime in substantial amounts but not more than that theoretically necessary to complete the saturation of the silicious compounds therewith, burning the whole to a clinker and grinding said clinker to cement.

(4) An improved process for the production of high grade cement which consists in intimately admixing a portland cement clinker comprising a large proportion of tricalcium silicate, free lime in substantial amounts and lower compounds of lime-silica, by grinding the clinker with lime, the total free lime content of the ground mass being not more than that theoretically necessary to complete the saturation of the lower lime-silica compounds, burning the whole to a clinker and grinding said clinker to cement.

(5) The improved portland cement having a tensile strength of at least 240 lb. per sq. in. at 24 hours with a 1 to 3 sand mixture and which is prepared by burning portland cement clinker comprising a large proportion of tricalcium silicate together with incompletely lime-saturated silicate, in intimate admixture with lime in amounts not more than that necessary to complete the saturation of the incompletely saturated silicate therewith, and grinding the resultant clinker to cement.

Claims in Patent No. 1, 700,033 are:

(1) A process for the production of high grade cement which consists in incorporating silica, alumina and iron with lime in substantially the theoretical amounts necessary to fully saturate silica, alumina and iron therewith, burning the mass thus obtained to incipient fusion, permitting the resultant product to cool, grinding said product, re-burning the ground product to incipient fusion, permitting the re-burned product to cool, and grinding the same to cement.

(2) A process for the production of high grade cement which consists in incorporating considerable more lime than will combine with silica, alumina and iron in one burning operation, but not more than substantially the theoretical quantity of lime necessary to fully saturate the silica, alumina and iron therewith, burning the mass to incipient fusion, grinding the resultant product, re-burning the ground product to incipient fusion, permitting the re-burned product to cool, and grinding the same to cement.

(3) A process for the production of high grade cement which consists in incorporating considerable more lime than will combine with silica, alumina and iron in one burning operation, burning the mass to incipient fusion, grinding the resultant product, incorporating more lime therein, the total lime content being not more than substantially the theoretical quantity of lime necessary to fully saturate the silica alumina and iron therewith, re-burning the ground product to incipient fusion, permitting the re-burned product to cool, and grinding the same to cement.

(4) An improved portland cement having a tensile strength in excess of 300 lb. per sq. in. at 24 hours in a 1 to 3 sand mix and which is prepared by incorporating silica, alumina and iron, with lime in amounts not more than that necessary to theoretically saturate the silica, alumina and iron therewith, but considerably more lime than will combine with silica, alumina and iron in one burning operation, burning the mass to incipient fusion, grinding the resultant product, re-burning the ground product to incipient fusion, and grinding the re-burned product to cement.

Cement Man Survives 2200-Volt Shock

PAUL F. KAYLOR, chief engineer at the Olympic Portland Cement Co., Bellingham, Wash., survived 2200 volts of electricity which passed through his body from arm to arm at the Balfour plant recently.

Mr. Kaylor was replacing a transformer at the company quarry at Balfour, six miles east of Sumas, when his hand came in contact with a live wire. Although an assistant ran some distance to shut off the current, Mr. Kaylor survived to tell the story, but was unconscious for some time. — *Sumas* (Wash.) *News.*

The accident occurred in connection with the restoration of machinery damaged in a recent quarry blast, and in the absence at the time of expert men of his force, Mr. Kaylor was himself replacing a transformer. One of his hands came in contact with a charged circuit.

Fortuately, Mr. Kaylor was at the time holding both hands up about on a level with his shoulders, so that the current passed through his chest and body above the heart, which undoubtedly saved his life. It is an electrical axiom that high voltage breaks the capillaries in the body, and if this should happen in a vital organ, like the heart or head, the result is death.

The power of the current burned a red trail across Mr. Kaylor's chest and back, and he was unconscious for some time after the current was shut off, the latter act requiring an assistant to run about a thousand yards to reach the vital switch.—*Bellingham* (Wash.) *American.*

Traffic and Transportation

Car Loadings of Sand and Gravel, Stone and Limestone Flux

THE following are the weekly car loadings of sand and gravel, crushed stone and limestone flux (by railroad districts) as reported by the Car Service Division, American Railway Association, Washington, D. C.:

CAR LOADINGS OF SAND, GRAVEL, STONE AND LIMESTONE FLUX

District	Limestone Flux Week ended Apr. 6	Apr. 13	Sand, Stone and Gravel Week ended Apr. 6	Apr. 13
Eastern	3,160	3,291	5,525	7,466
Allegheny	3,062	3,392	4,685	6,014
Pocahontas	497	606	685	715
Southern	368	580	9,656	9,340
Northwestern	1,139	1,069	3,996	5,147
Central Western	521	587	7,747	8,522
Southwestern	475	509	6,386	5,867
Total	9,222	10,034	38,680	43,071

COMPARATIVE TOTAL LOADINGS, BY DISTRICTS, 1928 AND 1929

District	Limestone Flux 1928 Period to date Apr. 14	1929 Apr. 13	Sand, Stone and Gravel 1928 Period to date Apr. 14	1929 Apr. 13
Eastern	30,072	36,150	41,306	39,590
Allegheny	42,802	43,006	44,356	41,697
Pocahontas	3,836	3,335	8,688	5,948
Southern	7,870	6,573	134,390	105,238
Northwestern	10,616	10,058	34,002	25,377
Central Western	5,940	7,455	87,444	86,152
Southwestern	5,914	6,020	68,297	73,539
Total	107,050	112,597	418,483	377,541

COMPARATIVE TOTAL LOADINGS, 1928 AND 1929

	1928	1929
Limestone flux	*107,050*	*112,597*
Sand, stone, gravel	*418,483*	*377,541*

Proposed Changes in Rates

THE following are the latest proposed changes in freight rates up to the week beginning May 4:

CENTRAL FREIGHT ASSOCIATION DOCKET

21271. To establish on **sand and gravel**, carloads, Ft. Harrison and South Terre Haute, Ind., to Cheneyville, Heaton, Johannott, Gundy and Knowles, Ind. Rate of 80c per net ton. Present rate—86c per net ton.

21275. To establish on **crushed stone**, carloads, Findlay and Lima, Ohio, to Albion, Ind., rate of 110c per net ton. Present rate—Sixth class rate of 16c.

21289. To establish on **sand and gravel**, carloads, Lorain, Ohio, to Wellington, Ohio, via N. Y. C. R. R.-C. C. C. & St. L. Ry., rate of 80c per net ton. Present rate—Sixth class rate of 200c per net ton.

21299. To establish on **sand**, viz., **blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding and silica**, carloads, from Glass Rock, Ohio to Mt. Vernon, Ohio, via N. Y. C. R. R., Glenford, B. & O. R. R., rate of 80c per net ton. Present rate—90c per net ton.

21306. To publish rates on **sand** (all kinds) **and gravel**, carloads, Krumroy, Ohio, to the following points (rates in cents per 2000 lb., except as noted):

To—	Delivery Line	Pro. Rates	Pres. Rates
Fairlawn, O.	A. C. & Y.	70	†9
Peninsula, O.	B. & O.	60	70
Fairport Harbor, O.	B. & O.	105	†14
Wickliffe, O.	N. Y. C.	85	*150
Willoughby, O.	N. Y. C.	90	*150
Mentor, O.	N. Y. C.	90	*150
Perry, O.	N. Y. C.	100	*150
Geneva, O.	N. Y. C.	100	*150
Ashtabula, O.	N. Y. C.	105	*150
Jefferson, O.	N. Y. C.	115	†16½
Macedonia, O.	P. R. R.	70	†11½

*Rate to Connenaut, O., but properly applicable under intermediate clause.
†Sixth class rate.

To establish a rate of 50c per net ton on **gravel and sand**, except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding and silica, carloads, from Columbus, Ohio, to Big Walnut, Ohio. Present rate—Sixth class. Proposed rate to expire six months after effective date.

21309. To establish rate of 100c per net ton on **grinding sand**, carloads, Ludington, Mich., to Rossford, O. Present rate—113c per net ton.

21338. To establish on **sand or gravel**, carloads, Richwood, O., to Forest, O., rate of 90c per net ton. Present rate—Sixth class rate of 240c per net ton.

> **Note 1—Minimum weight marked capacity of car.**
> **Note 2—Minimum weight 90% of marked capacity of car.**
> **Note 3—Minimum weight 90% of marked capacity of car, except that when car is loaded to visible capacity the actual weight will apply.**

21326. To establish on **crushed stone**, in bulk, in open cars, carloads, from Woodville, O., to Vanatta, O. (B. & O. R. R. delivery). Rate of 115c per net ton. Present rate—150c per net ton.

21327. To establish on **crushed stone**, in bulk, in open cars, carloads, from Lima, O., to Ada, O., via Penna. R. R., rate of 60c per net ton. Present rate—70c per net ton.

21328. To establish on **crushed stone and crushed stone screenings**, in bulk, in open cars, carloads, Lima, O., to Saratoga, Ind., via Penna. R. R., rate of 115c per net ton. Present rate—270c per net ton, sixth class.

21362. To establish on **crushed stone**, in bulk, in open cars, carloads, Sandusky, O., to Lima, O., via the Penna. R. R., rate of 90c per net ton. Present rate—300c per net ton.

21363. To establish on (a) **crushed stone**, carloads, from Lewisburg, O., and (b) **sand and gravel, carloads**, from Fort Jefferson, O., to Saratoga, Deerfield and Ridgeville, Ind., rate of 90c per net ton, to apply via C. C. C. & St. L. Ry., Meekers, O., and Penna. R. R. Present rates—Sixth class basis on crushed stone, from Lewisburg on sand and gravel; from Fort Jefferson, 92c to Saratoga, Ind., and 97c per net ton to Deerfield and Ridgeville, Ind.

21380. To establish on **crushed stone**, carloads, St. Paul, Ind., to destinations shown below, following rates (in cents per net ton):

To—	Pres. rate	Pro. rate
Indianapolis, Ind.	70	60
Gallaudet, Ind.	70	60
Acton, Ind.	70	60
Brookfield, Ind.	70	60
London, Ind.	70	60
Fairland, Ind.	70	55
Shelbyville, Ind.	60	50
Prescott, Ind.	60	50
Waldron, Ind.	60	50

21377. To establish on **refuse limestone screenings**, carloads, from Hillsville and Walford, Penn., to Neville Island, Penn., rate of 70c per ton of 2000 lb. Present rate—100c per ton of 2000 lb., per P. R. R. I. C. C. F1573, P. S. C. Penn. F519.

21386. To establish on **sand and gravel**, carloads, from Allison Branch, Ill., to Butlerville and Nebraska, Ind., rate of 110c per net ton, and to Holton, Ind., rate of 115c per net ton. Present rates—To Butlerville and Nebraska, Ind., 125c, and Holton, Ind., 126c per net ton.

21402. To establish on **sand and gravel**, carloads, Rittenhours, O., to Chillicothe, O., rate of 50c per net ton. Present rate—60c per net ton.

21404. To establish on **crushed stone**, carloads, East Liberty, O., to Lathrop, O., rate of 125c per net ton. Present rate—Sixth class.

21405. To establish on **sand and gravel**, carloads, Circleville, O., to destination shown below, following rates:

To—	Proposed rate	Present rate
Sugar Grove, O.	80	12
Brockbridge, O.	80	12
Jeffersonville, O.	80	11½
Logan, O.	80	12
Thrifton, O.	80	12
Thurston, O.	80	13
Sedalia, O.	90	14
Nelsonville, O.	85	13½
Bainbridge, O.	85	13½
Corning, O.	85	13½
Kingman, O.	100	14
Glouster, O.	90	13½
Hocking, O.	90	13½
Athens, O.	95	13½
Glen Jean, O.	100	11½
Jackson, O.	115	13

Present rates in cents per 100 lb.
Proposed rates in cents per ton of 2000 lb

21415. To establish on **crushed stone**, in bulk, in open cars, carloads, Woodville, O., to Berwick, O., C. C. C. & St. L. Ry delivery, rate of 80c per net ton. Present rate—230c per net ton, sixth class.

21418. To establish on **crushed stone**, in bulk, in open cars, carloads, Marble Cliff, O., to destinations shown below, following net ton rates:

Destinations—	Prop.	Pres.
Sturm and Dillard, O.	$0.80	$2.40
Minford, O.	1.05	3.30
Stockdale, O.	1.00	3.00

Present is classification basis.

13093. To establish on **lake sand**, in open top cars, carloads, from Bridgman, Oakhall and Sawyer, Mich., to Indianapolis, Ind. Rate of 126c per net ton. Present rate—139c per net ton, per C. F. A. L. Tariff 100V, I. C. C. 2128.

21443. To establish on **fluxing stone**, carloads, West Columbus, O., to points shown below, following rates, in cents per gross ton:

To	Pres.	Prop.
Barberton, O.	......	100
Columbus, O.	......	40
Ironton, O.	127	101
Jackson, O.	85	76
Portsmouth, O.	127	101
Ashland, Ky.	127	101
Marion, O.	......	101
Steubenville, O.	......	118
Youngstown, O.	......	126

21450. To establish on **sand** (except blast, core, engine, filter, fire or furnace, foundry, glass, grinding or polishing, loam, molding and silica) and **gravel**, in carloads, from Bemus Point, N. Y., to Angola, N. Y., rate of 80c per net ton. Present rate—Sixth class.

21462. To establish on **sand and gravel**, carloads, Vincennes, Ind., to Francisco and Oakland City, Ind., via Princeton and Southern Ry. Rate of 80c per net ton. Present rate—95c per net ton.

21451. To establish on **sand and gravel**, carloads, Cleves, O., to Brookville, Ind., rate of 50c per net ton. Present rate—76c per net ton.

21452. To establish on **sand and gravel**, carloads, Cleves, O., to New Point, Ind., rate of 70c per net ton.

21465. To establish on **crushed stone**, carloads, Huntington, Ind., to Alexandria, Ind., rate of 90c per net ton. Present rate—113c per net ton. Route—Wabash Ry., Wabash, Ind., C. C. C. & St. L. Ry.

21466. To establish on **crushed stone**, carloads, Ingalls, Ind., to various Indiana points (in cents per net ton):

To—	
North Salem, Ind.	88
Barnard, Ind.	90
Roachdale, Ind.	90
Raccoon, Ind.	95
Russellville, Ind.	95
Guion, Ind.	100
Marshall, Ind.	100
Bloomingdale, Ind.	105
West Melcher, Ind.	105

Present rate—Sixth class.

21467. To establish on **sand and gravel**, carloads, Columbus, O., to Willoughby, O., rate of 135c per net ton, to apply via C. C. C. & St. L. Ry., Cleveland, O., and N. Y. C. R. R. or N. Y. C. & St. L. R. R. Present rate—Sixth class.

SOUTHERN FREIGHT ASSOCIATION DOCKET

45046. **Sand,** from Millington, Ottawa, Oregon, Utica and Wedron, Ill., to southeastern points. It is proposed to establish for application via Metropolis, Ill., through commodity rates on sand, carload, from Millington, Ottawa, Utica, Wedron and Oregon, Ill., to Nashville, Knoxville, Tenn., Marietta, Atlanta, Columbus, Augusta, Ga., Birmingham, Anniston, Ala., and other southeastern destinations, said rates to be the same as combinations made on Evansville, Ind., or Cincinnati, O., whichever is lower.

45101. **Flint or quartz rock,** from Candler, N. C., to eastern destinations. It is proposed to establish the following reduced rates on rock, viz.: Flint or quartz rock, broken, crude, crushed or ground, carloads, minimum weight 60,000 lb., from Candler, N. C., to Baltimore, Md., 445c; Philadelphia, Penn., Trenton, N. J., 480c; Jersey City, N. J., 540c; New York, N. Y., 637c, and to Boston, Mass., 733c per net ton. Made with relation to rates in effect from Green Mountain, Kona and other C. C. & O. Ry. stations.

45106. **Limestone, ground or puverized,** from Cartersville, Ga., and Sparta, Tenn., to Henry, Va. Bristol, Tenn.-Va., combination now applies. Proposed rates on limestone, ground or pulverized, carloads (See Note 1), except when car is loaded to full visible capacity, actual weight will apply (not subject to Rule 34 of Southern Classification), to Henry (Franklin county), Va., from Cartersville, Ga., 310c; from Sparta, Tenn., 340c per net ton.

45128. **Phosphate rock,** from Twomey, Tenn., to Johnston City, Ill. It is proposed to establish a through rate of 371c per net ton on phosphate rock, crude, lump or crude ground, carload, from Twomey, Tenn., to Johnston City, Ill., to be applicable via N. C. & St. L. Ry. Paducah, Ky., P. & I. R. R., Metropolis, Ill., I. C. R. R., Herrin, Ill., and Mo. Pac. R. R., or the same as applicable for account of the C. & E. I. R. R. and I. C. R. R. as delivering carriers

45157. **Sand and gravel,** from Ellerslie and Warmore, Va., to Lawrenceville, Va. It is proposed to establish reduced rate of 110c per net ton on sand and gravel, carloads (See Note 3), from and to points mentioned.

SOUTHWESTERN FREIGHT BUREAU DOCKET

17324. **Agricultural limestone,** from Valmeyer, Ill., to points in Arkansas and Missouri. To establish the following distance scale of rates on agricultural limestone (for fertilizer purposes only), carloads (See Note 1), but not less than 80,000 lb., from Valmeyer, Ill., to points on the Mo. Pac. R. R. in Arkansas and Missouri on and south of the line from Illmo to Poplar Bluff, through Delta and Dexter, Mo.

Distance—	Rates
120 miles and over 80	5
160 miles and over 120	6
220 miles and over 160	7

There is a supply of this commodity at Valmeyer, Ill., and the rates proposed, it is stated, are as high as can be used in the distribution of this fertilizer. The rates proposed are also in effect at points on the M. & N. A. R. R.

17357. **Stone,** from points in Missouri to points in Iowa. To establish a rate of 21c per 100 lb. on stone, carloads, description and minimum weight as per Item 6310A, of W.T.L. Tariff 18M, from Carthage, Center Creek, Grand Falls, Meyers Spur, Phenix and South Greenfield, Mo., to Davenport and Des Moines, Iowa. Shipper directs attention to fact that both Davenport and Des Moines are intermediate to Chicago, and requests that similar adjustments be made to these points.

17401. **Sand and gravel,** from Richards Spur, Okla., to Acme, Tex. To amend Item 3106 of S. W. L. Tariff 26Y, applying on sand, gravel and stone from Richards Spur, Okla., to Acme, Tex., by providing a route in connection with the 7c rate to Acme, Tex., via C. R. I. & P. Ry., Lawton, Okla., St. L.-S. F. Ry., State Line (Carnes), St. L.-S. F. & T. Ry., Quanah, Tex., Q. A. & P. R. R., or via C. R. I. & P. Ry., Lawton, Okla., St. L.-S. F. Ry. (Carnes), and Q. A. & P. Ry. The proposed route is desired, it is stated, in order to meet a competitive situation.

WESTERN TRUNK LINE DOCKET

4264A. **Sand and gravel** (See Note 3), but not less than 40,000 lb., from Sioux Falls, S. D., to destinations in Iowa and Minnesota within 100 miles of Sioux Falls. Rates—Present: No joint rates. Proposed:

	Cents
50 miles and under	4.5
60 miles and over 50	5
70 miles and over 60	5.5
80 miles and over 70	6
90 miles and over 80	6.5
100 miles and over 90	7

2556-K. **Sand,** carloads, usual minimum weight, from Milwaukee, Wis., to Red Wing, St. Paul and Minneapolis, Minn. Present—$2.40 per ton of 2000 lb. Proposed—$1.60 per ton of 2000 lb. to Red Wing; $1.70 per ton of 2000 lb. to St. Paul and Minneapolis.

5369C. **Sand,** carloads (See Note 3), from Kansas City, Kan., and various other points in Kansas, to Faucett and Dearborn, Mo. Rates—Present and proposed to a few representative points are as follows:

From—	Present rate	Proposed rate
Kansas City, Mo.	70	70
Muncie, Kan.	100	70
Holliday, Kan.	110	80
Bonner Springs, Kan.	120	90
Lawrence, Kan.	120	90
Shockey, Kan.	......	90

4264-B. **Sand and gravel,** carloads (See Note 2), except that when weight of shipment when loaded to full visible capacity of car is less than 90% of marked capacity of car, the actual weight will apply; but in no case shall the minimum carload weight be less than 40,000 lb., from the Consolidated Sand and Stone Co.'s pit (Wheeler pit), near Sioux Falls, S. D., to stations on the G. N. Ry., I. C. R. R., C. R. I. & P. Ry. and C. M. St. P. &. P. R. R. Present—Combination of rates. Proposed—The following (rates in cents per 100 lb.):

Distance—	
50 and under	4.5
60 miles	5
70 miles	5.5
80 miles	6
90 miles	6.5
100 miles	7
115 miles	7.5
130 miles	8
145 miles	8.5
160 miles	9
175 miles	9.5
200 miles	10
225 miles	10.5
250 miles	11
275 miles	11.5
300 miles	12
325 miles	12.5
375 miles	13

ILLINOIS FREIGHT ASSOCIATION DOCKET

3934. To establish the following commodity rates on **stone, broken or crushed,** carloads, from Ohio river crossings. viz.: Brookport, Cairo, Ill., Evansville, Ind., Gale, Joppa, Metropolis, Mounds and Thebes, Ill. Rates in cents per 100 lb.:

To—	
Kansas City, Mo., St. Joseph, Mo., Atchison, Kan.	*15
Omaha, Neb.	*17½

*Not subject to Item 448 (combination rule).

3950. To establish for application via Metropolis, Ill., through commodity rates on **silica sand,** carloads, from Ottawa, Ill., and Oregon, Ill., to Nashville, Tenn., Marietta, **Atlanta,** Columbus, Augusta, Ga., Birmingham, **Anniston, Ala.,** and other southeastern destinations, **said rates to** be the same as combinations made on **Evansville, Ind.,** or Cincinnati, O., whichever is **lower.**

2859. **Sand and gravel,** carloads. usual minimum weight, from Chillicothe, Ill., to **Wabash Ry.** stations in Illinois. Rates in cents per net ton.

To (Rep. pts.)	Present	Proposed
Shops, Ill.	140	101
Curran, Ill.	140	126
Taylorville, Ill.	140	126
Wing, Ill.	126	101
Essex, Ill.	Comb.	101

3137. **Sand and gravel,** carloads, from Moline and Rock Island, Ill., to C. R. I. & P. Ry. destinations in Illinois. Rates in cents per net ton.

To (Rep. pts.)	Present	Proposed
Colona, Ill.	76	63
Annawan, Ill.	76	76
Wyanet, Ill.	88	76
Spring Valley, Ill.	101	88
Chillicothe, Ill.	88	88
Coal Valley, Ill.	76	63

4616. **Stone, crushed,** carloads (See Note 3), from Marshall, Ill., to stations on Indianapolis division of B. & O. R. R. Rates in cents per net ton. To representative points.

	Present	Proposed
Metcalf, Ill.	*	101
Murdock	*	101
Tuscola	*	113
Decatur	*	126
Springfield	*	126

*Class E.

4806. **Crushed stone,** carloads (See Note 1), from Joliet, Ill., to De Kalb, Ill. Rates per net ton. Present, 80c; proposed, 70c.

4956. **Sand, molding,** carloads (See Note 1), from Bowes, Ill., to Elgin and Carpentersville, Ill. Present—Class rates. Proposed—$1.39 per ton.

5025. **Sand,** carloads (See Note 3), but not less than 40,000 lb., from Chester, Ill., to **Metropolis,** Ill. Rates per net ton. Present, $2.30; proposed, $1.20.

4805, Sub. 1. To establish commodity rate on **sand, carloads, from Milwaukee, Wis., to Dubuque, Iowa, of $1.60 per ton, usual minimum weight.**

NEW ENGLAND FREIGHT ASSOCIATION DOCKET

16596. **Sand, sea,** carloads (See Note 2), from Provincetown, Mass., to Mexico, N. Y., 24½c. Reason—To establish rate to Mexico, N. Y., comparable with commodity rate in effect to Rochester, N. Y.

16625. **Common sand and gravel** (See Note 3), from East Weare, N. H., to Essex Junction, Vt., $1.75 per net ton. Reason—To establish commodity rate comparable with those now in effect for similar distances.

16639. **Silica sand** (See Note 3), from Bennington, Vt., to Watertown, Mass., $2.90 per net ton. Reason—To establish for benefit of shippers same rate as is at present in effect from Albany, N. Y., to Watertown, Mass.

16643. **Crushed or screened gravel and crushed or broken stone,** viz.: Granite, trap rock, quartz or sandstone, including grout, rubble or chips (waste products of quarries); minimum weight 50 tons of 2000 lb., from Scotia, N. Y., to Ushers, N. Y., 60c per net ton. Reason—To meet motor truck competition.

16716. **Stone, broken or crushed,** in bulk, in gondola or other open top cars (See Note 3), from Branford (Pine Orchard Quarry) to Southbridge, Mass., $1.20 per net ton (to expire November 30, 1929, unless sooner cancelled, changed or extended); Kingston, Mass., $1.25 per net ton (to expire December 31, 1929, unless sooner cancelled, changed or extended); from Middlefield (Reeds Gap Quarry), Conn., to Chestnut Hill, Conn., 60c per net ton (to expire August 31, 1929, unless sooner cancelled, changed or extended). Reason—To meet local ledge and barge-motor truck competition.

16753. (A) **Run of bank sand and gravel,** minimum weight 50 tons of 2000 lb.; (B) **crushed or screened gravel,** minimum weight 50 tons of 2000 lb., from East Weare, N. H., to Manchester. N. H. Present. A, 60c; B, 70c. Proposed, A, 50c; B, 60c. Reason—To meet motor truck competition.

16817. **Sand, building, common or run of bank** (See Note 1), from Onset to Watuppa, Mass. Present, 14c; proposed, 65c. Reason—To restore rate that expired December 31, 1928.

TRUNK LINE ASSOCIATION DOCKET

20665. **Stone, crude, broken or rough,** carloads (See Note 2), from Advance, Penn., Deerfield, Md., Fairfield, Penn., Flint, Md., and Gladhill. Penn., to Danville, Ill., $4.30 per net ton. Reason—The proposed rate is the same as now applicable on stone chips or granules, as per Cudlett's I. C. C. A239.

20658, Sup. 1. **Building sand,** carloads (See Note 2), from Hancock-Tonoloway District to Staten Island Junction to Tottenville, N. Y., inclusive, $3.55 per net ton.

20671. **Crushed stone,** carloads (See Note 2), from Water Gap, Penn., to Lake Ariel, Penn., $1.10 per net ton. Reason—The proposed rate is comparable with rates on like commodities from and to points in the same general territory.

20691. **Crushed stone,** carloads (See Note 2).

	From—		
To (Penn.)—	Beavertown Penn.	Dalmatia, Penn.	Pond Hill, Penn.
So. Danville	....	85	....
Catawissa	....	85	....
Creasy	....	....	75
W. Nanticoke	....	....	80
Nanticoke	....	120	....
Hazleton	....	110	85
McAdoo	....	....	85
St. Clair	....	130	....
Selinsgrove	75	75	....
Northumberland	....	85	....
Lewisburg	95	....	....
Glen Iron	....	100	....
Milton	....	85	....
Williamsport	....	110	....
Lykens	....	85	....
Williamstown	....	85	....
Turbotville	....	95	....
Strawberry Ridge	....	95	....
Millville	120	110	....
Berwick	....	120	145

The above rates in cents per net ton.

Reason—The proposed rates are comparable with rates now in force from Shamokin, Northumberland, Shickshinny, Penn., etc.

20697. **Crushed stone,** carloads (See Note 2), from Barree, Union Furnace, Tyrone Forge and Stover, Penn., to Ebensburg, Penn., $1 per net ton. Reason—The proposed rates are comparable with rates now in force from Water Street, Goodman, Carlim, Penn., etc., to Ebensburg, Penn.

20701. **Sand (blast, engine, fire, foundry, glass, molding, silex or silica),** carloads, from Palmerton, Penn., to Aquashicola, Palmerton, Palmerton (Delaware Ave.) and Palmerton (East) Penn., 80c per net ton. Reason—The proposed rate is the same as now in effect on low-grade sands from and to the same points.

20702. **Stone, crushed or quarry broken,** carloads (See Note 2), from Munns and Oriskany Falls, N. Y., to Randallsville, N. Y., 60c per net ton (to expire December 31, 1929). Reason—The proposed rate is comparable with rates from Oriskany Falls, N. Y., and Solsville, N. Y., to New Hartford, N. Y.

20712. **Sand** (other than blast, engine, foundry, glass, molding, quartz, silica or silex) and **gravel,** carloads (See Note 2), from Solsville, N. Y., to Randallsville, N. Y., 50c per net ton (to expire December 31, 1929). Reason—The proposed rate is comparable with rates from Winterton, N. Y., to Middletown and from Solsville to Utica, N. Y.

20722. **Sand,** carloads (See Note 2), from Kenvil, N. J., to Hurd, N. J., 70c per net ton. Reason—The proposed rate compares favorably with rates on like commodities for like distances, services and conditions.

20724. **Gravel and sand** (except blast, core, engine, fire, foundry, glass, molding, quartz, silex or silica), carloads (See Note 2), from Pittsburgh, Penn., to Saxton, Penn., $1.70, and to Riddlesburg, Penn., $1.80 per net ton. Reason—The proposed rates are comparable with rates on like commodities between points in the same general territory.

20725. **Limestone, ground or pulverized, and limestone dust,** carloads, minimum weight 50,000 lb., from Jamesville, N. Y., to B. R. & P. Ry. stations—Johnsonburg, Penn., and south (except Chewton to New Castle, Penn., incl.), $2.60; to Chewton to New Castle, Penn., incl., $2.90 per net ton. Reason—The proposed rates are comparable with rates from Syracuse rate points to 60 to 67% territory.

New Scale Proposed for Sand, Gravel and Crushed Stone in Southwest

THE Interstate Commerce Commission in cooperation with various state railway commissions has undertaken an investigation of intrastate and interstate rates on sand, gravel, crushed stone and similar products in Arkansas, Oklahoma, Texas and Louisiana west of the Mississippi river. Acting through the instrumentalities of the National Sand and Gravel Association and the National Crushed Stone Association, the producers merged their interests in the case and presented their evidence jointly under the supervision of one attorney, Frank A. Leffingwell, of Dallas. It might be said in passing that this is apparently the first major instance where the two industries united in fighting a common traffic problem.

It was agreed at the outset of the hearing that the commodity description should read as follows: "Sand, except asbestos sand; gravel; crushed stone (broken stone ranging in size up to 200 lb. weight), including ground limestone in bulk or in bags, but not including gypsum rock; riprap (irregular-shaped rock) in pieces ranging up to 200 lb. in weight; clay (except ground clay in bags and treated or milled fire clay); common shells, whole or crushed; crushed tile and crushed sewer pipe (imperfect hollow tile and sewer pipe crushed for use instead of crushed stone); soil; cinders; crushed bricks or brickbats; chats (mine gravel), whole or crushed; and slag, not pulverized; in bulk, in straight or mixed carloads."

It was brought out by competent testimony that sand, gravel and crushed stone have practically no terminal expense at one end of the line and less than the average at the other end, that the transportation hazard amounts to nothing, that the materials do not require expedited service and

TABLE 1

Distance scales of rates in cents per ton of 2000 lb.

Distance	Single-line rate	Joint-line rate
10 miles and under	55	70
20 miles and over 10	60	75
30 miles and over 20	65	80
40 miles and over 30	70	85
50 miles and over 40	75	90
60 miles and over 50	80	95
70 miles and over 60	85	100
80 miles and over 70	90	105
90 miles and over 80	95	110
100 miles and over 90	100	115
110 miles and over 100	105	120
120 miles and over 110	110	125
130 miles and over 120	115	130
140 miles and over 130	120	135
160 miles and over 140	130	145
180 miles and over 160	140	155
200 mlies and over 180	150	165
230 miles and over 200	160	170
260 miles and over 230	170	180
290 miles and over 260	180	190
320 miles and over 290	190	200
350 miles and over 320	200	210
380 miles and over 350	210	220
410 miles and over 380	220	230
440 miles and over 410	230	235
470 miles and over 440	240	245
500 miles and over 470	250	250
530 miles and over 500	260	260
560 miles and over 530	270	270
590 miles and over 560	280	280
620 miles and over 590	290	290
650 miles and over 620	300	300
680 miles and over 650	310	310
710 miles and over 680	320	320
740 miles and over 710	330	330
770 miles and over 740	340	340
800 miles and over 770	350	350

that the freight charges are a very large part of the delivered price.

The tentative report submitted to the Interstate Commerce Commission by Examiner Waters stated, in part, that "the record discloses a rate situation affecting the transportation both interstate and intrastate of these commodities throughout the considered territory that needs correction, and what is here needed is a reasonable scale that will be harmoniously applied throughout the territory." Mr. Waters held further that the "scales here proposed and known as the shippers' proposed scales, but which appear to be chiefly sponsored by the respective highway commissions, should not receive

TABLE 2

Distance scales of rates in cents per ton of 2000 lb.

Distance	Rate
10 miles and under	60
20 miles and over 10	65
30 miles and over 20	70
40 miles and voer 30	75
50 miles and over 40	80
60 miles and over 50	85
70 miles and over 60	90
80 miles and over 70	95
90 miles and over 80	100
100 miles and over 90	105
110 miles and over 100	110
120 miles and over 110	115
130 miles and over 120	120
140 miles and over 130	125
160 miles and over 140	135
180 miles and over 160	145
200 miles and over 180	155
230 miles and over 200	165
260 miles and over 230	175
290 miles and over 260	185
320 miles and over 290	195
350 miles and over 320	205
380 miles and over 350	215
410 miles and over 380	225
440 miles and over 410	235
470 miles and over 440	240
500 miles and over 470	250
530 miles and over 500	260
560 miles and over 530	270
590 miles and over 560	280
620 miles and over 590	290
650 miles and over 620	300
680 miles and over 650	310
710 miles and over 680	320
740 miles and over 710	330
770 miles and over 740	340
800 miles and over 770	350

approval by this commission, for they are much too low for application in this territory."

Mr. Waters recommended that the distance scale of rates shown in Table 1 should be held by the commission to be the reasonable maximum interstate rates for single-line hauls and joint-line hauls, and the distance scale of rates shown in Table 2 should be established as the reasonable maximum.

A vigorous exception to the report of the examiner was filed by Mr. Leffingwell in behalf of shippers. After dismissing the possibility that the commission would consider prescribing one scale for both single and joint-line service in face of opposition to such a scale from all parties to the proceedings, it was contended that the scale of rates contained in Table 1 has four vital defects: First, the mileage blocks are not properly constructed; second, it is not properly graded; third, it is too high to permit free movement of traffic of this nature; fourth, there is too great a spread between the single-line and joint-line rates.

It is rather unlikely that the commission will render a final decision in the case in time to have any effect on this year's business.—*National Sand and Gravel Bulletin.*

Operation of New Rates on Cement Is Deferred

BY an order entered April 8 in Investigation and Suspension Docket No. 3271, the Interstate Commerce Commission suspended from April 10, 1929, until November 10, 1929, the operation of certain schedules as published in Supplement No. 12 to Agent J. E. Johanson's tariff I. C. C. No. 2032.

The suspended schedules propose to cancel the application of the present arbitraries on cement from certain points in Illinois, Indiana, Iowa, Kentucky, Minnesota and Wisconsin to Cairo, Ill., East St. Louis, Ill., Hannibal, Mo., Memphis, Tenn. and Kansas City Mo. used in constructing through rates on shipments to destinations beyond Arkansas and Louisiana, which generally would result in higher combination rates on such traffic.

Operation of New Rates on Lime Is Deferred

BY an order entered April 19, in Investigation and Suspension Docket No. 3279, the Interstate Commerce Commission suspended from April 20, 1929, until November 20, 1929, the operation of certain schedules as published in Supplement No. 6 to Agent J. H. Glenn's tariff I. C. C. No. A-684.

The suspended schedules propose to increase the rates on lime, carloads, from kilns in Maryland, Pennsylvania, Virginia and West Virginia to Ohio river crossings St. Louis, Mo., East St. Louis, Ill., also Kentucky and Tennessee points.

Why Air Receivers Explode

A Comprehensive Discussion of the Various Causes Leading Up to Accidents of This Type

Richard H. Britt
Consulting Engineer, Rockland, Maine

THE EXPLOSION of air receivers is by no means uncommon. It has been said that we see little of them in the technical papers because the management of the concerns interested are loath to give out the facts. Even the managers are sometimes, perhaps usually, not in possession of all the facts. The man in charge of the compressor probably knows more facts bearing on the matter than any one else, but he sometimes does not survive the explosion. Even if he does survive, the facts usually include those that may reflect on his knowledge and judgment. The builders of the compressor may also be in possession of information that should have been imparted before the explosion, but is not likely to be imparted after the explosion.

The causes that lead to these accidents are generally conceded to be a condition that brings about the presence of an explosive mixture of air and gas in the delivery pipes of the compressor and in the receiver, and a condition in the compressor and discharge pipes that builds up an igniting temperature. Then the explosion starts at the compressor and passes through the connecting pipe to the receiver.

All oil that is put into the compressor for lubricating purposes cannot be so utilized. Some goes out with the compressed air in the form of a fine spray or attached to particles of dust; and these, striking the inside of the passages and receiver, form a cake of oil and dust that is combustible. The oil is capable of being distilled or "cracked," and the dust may be anything that finds its way into the intake pipe. It may be inert matter, as road dust, or it may be largely wood fiber and other organic matter, including cotton fiber, or what is worst of all, coal dust. There is an excess of receiver explosions around coal mines and this is generally attributed to the presence of coal dust in the caked material inside the pipes and receiver. It is conceivable that coal dust alone, held in suspension in the air of a receiver, might cause an explosion, but the chances of so much dust reaching the receiver at a time when conditions are right for building up an ignition temperature are very remote. In any case this caked material is ready to give up explosive gases under temperatures that are easily produced by abnormal conditions.

If the cooling system of the compressor were perfect we should have isothermal compression with air delivered at the temperature of the intake. In the absence of any cooling system we should have near adiabatic compression and the air would be delivered at about the temperature indicated by the formula.

$$T' = T\left(\frac{P'}{P}\right)^{0.29}$$

Where T is the absolute temperature of the intake air.
Where P is the absolute pressure of the intake air.

> ### *Author's Note*
> ***THE EXPLOSION of the compressea air receiver at Decatur, Ga., on February 28, 1929, was described in "Rock Products" of March 16 by W. B. Lenhart, associate editor. His description of the results were full and clear and the readers of your journal are fortunate that a coincidence found him near Decatur at that time. The enclosed paper is intended to be at least a partial answer to his question, "What furnished spark or heat?"—The Author.***

Where T' is the absolute temperature of the discharge.
Where P' is the absolute pressure of the discharge.

Given a compressor taking air at 60 deg. F., or 520 deg. absolute, and 14 lb. absolute pressure, and delivering air at 100 lb. gage, or 114 lb. actual pressure. Substituting in the formula we have

$$T' = 520\left(\frac{114}{14}\right)^{0.29} = 520 \times 1.837 = 955 \text{ deg. absolute}$$
$$= 495 \text{ deg. F.}$$

This is the temperature that would be produced in an ideal cylinder with non-conducting walls and piston. But with ordinary water-jacket cooling it is probably kept down to around 350 deg. to 400 deg. F., so that with a lubricating oil of a high flash test, say, 500 deg. F., inflammable gases will not be driven off under normal working conditions.

Haslam and Russell give the following ignition temperatures, at atmospheric pressure, for the substances named:

	Degrees Fahrenheit
Powdered lignite	302
Powdered gas coal	392
Powdered hard coking coal	482
Powdered anthracite	572
Kerosene	573
Pennsylvania crude	601
Cylinder oil	783
Ethel alcohol	1036
Carbon monoxide	1200
Methane	1300

But these temperatures (for the oils) are lowered by an increase in pressure, generally about 100 deg. for 100 lb. pressure.

The most prolific cause of heating at the discharge and consequent burning out or "flaming" of the discharge pipe and explosions is trouble with the exhaust valves. If they leak from sticking or other cause there is likely to be real trouble.

As an extreme case, in the compressor above given, consider a valve or a set of valves that allows part, say, one-fourth, of a charge of air to leak back into the cylinder at each revolution. The leaking air is already at a temperature of, say, 350 deg. F. It follows the piston air expands without doing work, so that the heat it carries is distributed to the main charge of air and brings the temperature of the whole to about 130 deg. By the formula above this charge would compress to a temperature of about 600 deg. or 100 deg. higher than the previous charge and furnish a still hotter charge for the next stroke. By this process there would be built up immediately a temperature sufficient to crack the highest flash test oil and the interior lining of caked material would be set on fire.

Importance of Tight Valves

The importance of tight valves is more fully realized when it is remembered that the leak begins to operate at the end of the compression stroke and continues with full discharge for the whole of the intake stroke, and with diminishing discharge for approximately three-fourths of the compression stroke. The results of a leaky condition of the valves are aggravated by slowing down the compressor. If run at half speed, double the quantity of air will leak back into the cylinder at each revolution.

High temperatures may also be built up by choking of the air passages or exhaust pipes by the building up of excessive deposits of caked material as above described. A 6-in. pipe with a 1-in. caked lining has lost 56% of its area and 65 to 70% of the carrying capacity for which it was designed. To

force the successive charges of air through the passages thus constricted requires excess pressure with corresponding temperatures which will increase with the thickness of the cake.

Spontaneous combustion may be blamed for some ignitions. Oil-soaked fibrous material, not to mention coal, is notorious for ignitions under conditions of moderate temperature. Certainly the conditions in a receiver or in the pipes leading to it would seem ideal for producing this effect.

Here, then, are three causes that may produce high temperature in the exhaust. What probably takes place to bring about the actual explosion is that the temperature is slowly built up to where the caked lining is freely giving off gases so that the pipes and the receiver are filled with the explosive mixture made richer by each stroke of the piston until the ignition temperature is reached.

In the case of what is known as "flaming," or the burning out of the exhaust pipes, it is likely that the temperature comes up quickly and fires the caked lining before much gas has been given off. Thereafter the receiver and pipes beyond are supplied with the products of combustion instead of an explosive mixture. I have seen a discharge pipe at a red heat for 10 ft. from the compressor but no explosion took place.

Sometimes Bad Air From Pipe Lines

These gases contain the practically inert carbon dioxide and the poisonous carbon monoxide. They are harmless if used for machine drilling in the open air, as in a quarry, but in a mine they have to be reckoned with. A case is on record where four men working in a raise with an air drill noticed that the air was getting bad. Not dreaming that the trouble was from the exhaust of their machine, they turned on a full head, as was customary to freshen the air. Two died from the effects of the fumes and the other two barely escaped with their lives. At the same time two men drilling in a winze in another part of the same mine were overcome but were gotten out alive at the risk of other lives. It was found at the compressor that the exhaust pipe had been red-hot and set fire to the compressor house. The compressor man's attention was first called to the trouble by hearing a small explosion. It may be noted here that in a number of reported cases of "flaming" first attention was attracted by a minor explosion. In the case just cited the receiver did not explode, and the men were believed to have been overcome by carbon monoxide gas.

The compressor man had been mixing a lighter oil with heavy cylinder oil and this was doubtless the major cause of the accident. However, a leaky valve or a choked outlet was the most probably immediate cause of the ignition.

What precautions should be taken to avoid ignitions in compressors and discharge pipes with their disastrous consequences? Stage compression with ample intercooling and aftercooling is almost complete protection against major explosions, besides being more economical in operation. But it is not complete protection against ignitions and minor explosions in discharge passages and pipes. Only the best and highest, flame-test lubricating oil should be used in the cylinders and this in the smallest quantity permissible. Also an arrangement should be installed for the feeding of soap and water for cleaning the valves and for lubrication if desired, care being taken to feed oil and run the machine a few minutes before closing down, thus preventing rust.

Precautions Against Receiver Explosions

The discharge valves should be cleaned and examined for leaks once a week or oftener. There should be a thermometer in the discharge pipe, and a thermostat connected to sound a bell or whistle for a temperature above about 400 deg. The receiver should have an ample drain and a manhole. It should be drained every-day and inspected through the manhole once or twice in a year. The air should be taken from the outside and should be free from dust. If an excess of coal dust cannot be avoided it should be water sprayed before entering the intake. The compressor man should be made acquainted with the duties of his job and the dangers of neglect, and a printed explanation of these dangers should be posted in the compressor room, and care taken that he understands it.

In the preparation of this paper I have consulted the following:

Peele's "Compressed Air Plant for Mines." Chapter XIV.

Haslam and Russell, "Fuels and Their Combustion."

Albert R. Ledoux, *Trans.* Am. Inst. Mining Engineers. Vol. XXXIV, p. 158.

Alex M. Gow, *Engineering News.* March 2, 1905.

E. Goffe, *Eng. and Min. Jour.* April 28, 1904.

Collaborates in Research on Closed-Circuit Grinding

EXPERIMENTS that may produce a new method of grinding the raw materials and clinker in the manufacture of cement and that may improve the process used for years in crushing copper, gold, zinc and other ores preparatory to smelting are being made at the Mines Experiment Station at the University of Minnesota by E. W. Davis, superintendent.

The importance of the work is such that Harry W. Newton of Chicago, conservation engineer for the Portland Cement Association, went to the University recently to spend two or three months collaborating with Mr. Davis, with special reference to cement-making possibilities arising from the experiments. Mr. Newton has had several carloads of raw materials and clinker shipped to the station to be used in research work.

Mr. Davis began experimenting with grinding processes 15 years ago. Ten years ago he read a paper before the American Institute of Mining Engineers in which he reported his conclusion that the capacity of a grinding unit increased in almost direct proportion to an increase in the circulating load. His experiments had proved, he said, the greater efficiency of closed-circuit grinding as compared with one-passage grinding. His contribution to the subject lay in pointing out the greater grinding capacity with no increase in the size of the ball mill gained by increasing the tonnage circulated.

In one-passage grinding, used almost universally up to now in cement making, raw materials and clinker are fed to the mill at a rate insuring the desired fineness.

In closed-circuit grinding no effort is made to obtain the proper fineness in one passage through the mill. The discharged material is sent through a sizing device and all material not ground fine enough is sent back into the mill along with the new feed. This makes a continuous or closed-circuit process.

The grinding is ordinarily done in a ball mill consisting essentially of a large rotating steel cylinder half filled with high-carbon chilled steel balls.

Mr. Davis has found that the greater the amount of material on which the mill is working the greater the efficiency of the progress. The size of the mill does not have to be increased. The horse-power consumed in grinding remains the same. The only chance necessary to produce an increased output is the increasing of the capacity of the sizing units. These are simple machines requiring little power.

Mr. Newton came to Minnesota to find out if the closed-circuit grinding method can be applied to cement manufacturing.

Mr. Davis has had the satisfaction as a result of his researches of seeing ore crushers on the Mesabi range and elsewhere running with greatly increased loads.—*St. Paul* (Minn.) *Dispatch.*

Birmingham, Ala., Has Another Commercial Slag Plant

THE SLOSS-SHEFFIELD STEEL AND IRON CO., Birmingham, Ala., has recently completed a large modern addition to its slag screening equipment at the City Furnace plant, First avenue and 32nd street, and is now prepared to deliver slag to any part of the city.

Heretofore, the company has not been delivering slag, but has quoted a price at the bins and the customer has found it necessary to arrange for drayage. However, this now has been changed and the company will deliver slag of all standard sizes promptly on receipt of orders.

L. L. Iddings, formerly manager of the Alabama Sand and Gravel Co., Montgomery, has been appointed manager of the slag department.—*Birmingham* (Ala.) *Post.*

Cement Products

TRADE MARK REGISTERED WITH U. S. PATENT OFFICE

Following the Order Through from Salesman to Job

The Cement Products Plant of A. W. Friske, Alois, Wis., Devises a Fine System of Recording Orders, Estimates and Deliveries

By D. R. ("Spec") Collins

IT is one thing to get an order for concrete block, but it's an entirely different thing to follow it through the office and see that it is delivered intelligently and that no mistakes are made. At the products plant of A. W. Friske, Alois, Wis., we have devised two forms to assist us in this follow through, that, though extremely simple, tell the complete story at a glance.

Figuring the Job

First we devised an order book that would, if completely filled out, give all the essential information for figuring the job. By far the majority of jobs are basement jobs and it was with this in mind that the order book was arranged. Feeling that the address that the job was to be delivered to was essentially the first thing we wanted to know, we placed this first rather than the name of the contractor which was placed at the bottom of the sheet. Another reason for placing the name of the contractor last was that it might be signed by him as a signed order after the rest of the information had received his approval.

Of course we want to know the size of the job, so after the address, we have a place for the building size. Then the job may be rock face or brick veneer above grade so provision has been made for noting this also. Then again the number of courses of various units vary. In this community the usual number of courses below grade is six, though of late there is a tendency toward seven courses below grade and three above. Of course the width of block is essential. In Milwaukee, frame construction requires a 10-in. foundation while brick veneer buildings must have no less than 12-in. Some of the suburbs require no larger than an 8-in. foundation. That makes the size of block to be used an essential bit of information for many contractors prefer to use the larger sizes even though not required to do so by the building ordinance of the city or village they are operating in. The number of corners is mighty essential. One of the examples used to accompany this article shows that the particular job cited had ten corners. The contractor would have been in somewhat of a mess if the man in charge of deliveries had taken it for granted that the job had but four corners and had made deliveries accordingly.

ORDER SHEET No. 201

A. W. FRISKE
4715-23 STATE STREET
BLUEMOUND 384

Date 12-6-1928
Deliver to 423-54th St
Size 24x45
Courses Plain 6 Width 10"
Courses Rock 4 Width "
Courses Slabs Width
Number of Corners 8
Number of Window Openings 8
Other Openings NONE
Sills 8 Size 4x11x33
Chimney NO Size
Post Foundation Blocks 4
Special Blocks (Fireplace below)
Delivery to Start 12-7
Buyer HARRY SARNOW
Address
Phone
FIREPLACE NOTES EXTRA
(30-8x8x16 Pcn)-(6-8x8x16Co)
(12-8x5x16 Slabs)
"RELIABLE CONCRETE BLOCKS"

Typical Order Sheet

Of course we want to know the number of window openings so that we can make the proper deductions and furnish the correct number of half blocks to make a workmanlike job around these openings. Grade openings, whether in the middle of the house or on the corner must be noted also so that deductions can be made. There is a good profit in post foundation blocks, but it was found that these were seldom included in the order unless some mention was made of them. So they were added to the list.

One thing has been left off the order sheet that I would include if I were redesigning it—whether the front of the building is to be plain, half plain or full. By that I mean whether the porch runs completely across the front, half way across the front, or if there is no front porch at all. The reason for this is that it is customary to furnish plain blocks under the porch above grade. This is in reality a small item, but the contractor usually appreciates this small saving. In taking the order this is usually forgotten unless there is something on the order blank to remind the man taking the order to make inquiry about it.

Then there is a place on the order blank for notes. Often some special directions have to be given for reaching the job or there is not enough room under the notation "Special Blocks" to include a full description of everything needed. If this order blank is filled out completely there should be no difficulty in the office when the job is started on its way.

Loose Leaf Record

To follow each job more completely we utilized the office mimeograph to make a duplicate of the order blank on a sheet that could be fitted in a loose leaf book. This book was then kept handy on the desk from which each load was billed out. This not only was filled out to show a duplicate of the order as the salesman turned it in, but also provided a space for estimating the actual number of each size of unit needed to complete the job.

To understand the method, let us take an actual example. It is our custom to include most of the corners with the first load, and hence, in the first job illustrated, the entire 48 corners were sent with the first load. The balance of the load was made up of plain blocks. A notation was made in pencil beside the typewritten "48" in the estimate column showing that this number of corners was already on the job. At the same time a notation was made beside the typewritten "610" to show that the balance of the load, made up of 112 plain blocks, had been sent. The next load to go on this job was 160 plain blocks. The 112 was then erased and 272 written in its place to show the number of plain blocks delivered up to that time. This is continued on through in logical order until the entire job has been delivered. If the job is figured accurately there should be no mistake in getting the correct number of units on each job and in the proper order.

To illustrate, the cuts show two typical orders as turned in at the office and also a sheet from the loose leaf book in which these two orders are recorded and the job figured. The reader can easily follow these through. They show exactly how it is done and how the job is carried through to completion.

Physical Properties of Precast Stone

THE TESTS to determine the physical properties of precast stone with the object of preparing Federal Government specifications for this material have been continued by the U. S. Bureau of Standards. Forty-four samples were submitted by 20 manufacturers located throughout the United States. A few changes have been made in the method of testing since the previous description was published. The dry weight of specimens was determined by heating at 110 deg. C. until constant weight was obtained, which usually required about 72 hours. Compressive strength is determined on cylinders 2 in. in diameter and 2 in. high, a size selected because specimens of homogeneous material could be obtained from most samples of stone, including the type with facing. The compressive strengths ranged from 1760 to 10,300 lb./in.². Some 21% of the specimens had strengths of over 8000 lb./in.², 58% over 6000 lb./in.² and 91% over 4000 lb./in.². Modulus of rupture determinations were on 1x1x8 in. prisms tested on a 6-in. span, and results varied from 180 to 1575 lb./in.². Some 22% of the specimens had a strength of more than 1100 lb./in.², 45% more than 900 lb./in.² and 91% more than 500 lb./in.². The rate of absorption was determined under the condition of total immersion in water on the broken halves of the modulus of rupture specimens. The amount of water absorbed, expressed in percentage of dry weight of specimen, was determined after ½, 2, 4, 6, 24 and 48 hours, and also after five hours' subsequent boiling. At one-

DELIVERY SHEET

ORDER NO. 201 DATE Dec 7, 1928

Name Harry Sarnow
Address 423 - 54th St
Size 24x45
Courses Plain 6 Width 10"
Courses Rock 4 Width 10"
Courses Slabs ____ Width ____
Corners 8
Window Openings 8
Other Openings None
Front Rock
Sills 4x11x38
Post Blocks 4
Specials 8" and Slabs for Fireplace
Additions ____

101 Blocks to the course.

ESTIMATE

Del.	Est.	Size
48	48	8x10x16 Plain Corners
600	610	8x10x16 Plain
32	32	8x10x16 Rock Corners
12	12	8x5x16 Slabs
30	30	8x8x16 Plain
6	6	8x8x16 Plain Corners
4	4	8x8x8 Solids
8	8	4x11x38 Sills
32	32	8x10x8 Rock
210	204	8x10x16 Rock

Notes.

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ORDER NO. 202 DATE Dec 7, 1928

Name Jos. La Croix
Address 2042 - 29th Street
Size 25x53
Courses Plain 6 Width 12"
Courses Rock ____ Width ____
Courses Slabs 4 Width 8"
Corners 10
Window Openings 11
Other Openings 7x8 Corner
Front ____
Sills ?
Post Blocks None
Specials ____
Additions ____

115 Blocks to the Course.

Del.	Est.	Size
60	60	8x12x16 Plain Corners
630	630	8x12x16 Plain
36	36	8x8x16 Plain Cor
48	48	8x8x8 Plain Cor
267	267	8x8x16 Plain
✓	11	4x6x32 Sills

Notes Sills later

Sheet from loose leak record book showing estimated figures for job

ORDER SHEET No. 202

A. W. FRISKE
4715-23 STATE STREET
BLUEMOUND 384

Date 12-7-1928
Deliver to 2042 - 29TH ST
Size 25 x 53
Courses Plain 6 Width 12"
Courses ~~Rock~~ Plain 4 Width 8"
Courses Slabs ____ Width ____
Number of Corners 10
Number of Window Openings 11
Other Openings 7x8 CORNER
Sills LATER - Size ____
Chimney LATER Size ____
Post Foundation Blocks NO
Special Blocks —
Delivery to Start AT ONCE
Buyer JOS LA CROIX
Address ____
Phone ____

NOTES

LENGTH OF SILLS LATER
DELIVER FROM ALLEY

"RELIABLE CONCRETE BLOCKS"

Another example of order blank used by Wisconsin cement products manufacturer

half hour the absorption ranged from 0.8 to 13.1%; 50% of the specimens absorbed less than 5%. At 24 hours the range was from 2.4 to 14.0%. Only 7% of the specimens absorbed less than 5%. At 48 hours the range was from 3.5 to 14.0%, 3% of the specimens absorbing less than 5%. After five hours' boiling the range was from 7.7 to 19.2%. Only 13% of the specimens absorbed less than 8% of water.

The ability to withstand weathering has been determined by cycles of alternate freezing and thawing. The specimens for this test are cylinders similar to those used in the compression test. The test specimens are placed in water for 48 hours previous to the first freezing cycle. The freezings are made while the specimens are standing in one-fourth of an inch of water. Less than one-third of the specimens have reached the end point, or point of complete failure or disintegration, and for this reason no definite conclusions as to the value of the other tests as an indication of the ability to resist freezing can be stated at this time. The end point has been reached at a minimum of 65 cycles and a maximum of 380 cycles in those specimens where the tests have been carried to completion. A half dozen specimens have already withstood 475 cycles without any indications of failure.—*Technical News Bulletin* of the U. S. Bureau of Standards.

Pennsylvania Railroad Tests Concrete Ties

AFTER years of sporadic (and sometimes futile) endeavors to produce a concrete tie, a real effort is being made to develop one which will be really adapted to its purpose. The Pennsylvania railroad has acquired several thousand of a new type from the Concrete Tie Co., Pittsburgh, Penn., and is testing them on three miles of its main line between Pittsburgh and Philadelphia and on branch lines. The principal difference between the new tie and former ties is that the new tie is really designed for the work it has to do. The following description of the tie is taken from *Railway Engineering and Maintenance:*

The tie which is now being installed does not differ greatly as to size and shape from the standard wooden tie. It is 8 ft. long, 10 in. wide and 8 in. high, except that the ends are raised for a length of about 11 in. to provide a shoulder to receive the thrust of creosoted oak blocks 14 in. long, 5 in. wide and 1¾ in. thick, which serve as rail seats. Two octagonal holes pass through the tie at the rail set to receive 3-in. creosoted oak spiking plugs.

No change in the customary rail fastening is involved in the design, except that longer spikes are used to make up for the thickness of wooden tie blocks and to provide sufficient penetration into the spiking plugs. The tie plate differs from those used on wooden ties in that it is shortened somewhat in length and the edges are rolled down so as to compress the wooden tie blocks. This makes up to a certain extent for the reduced bearing area under the rail as compared with the full width of a wooden tie. These tie plates weigh 11½ lb. each and the steel reinforcement for one tie weighs about 57 lb.

The Design

The tie is designed to carry a locomotive wheel load of 127,200 lb. (including the impact allowance). This load is assumed to be distributed over three ties, making a total load of 42,400 lb. for each tie. The roadbed reaction is assumed as uniformly distributed over the entire length of the tie, amounting to 5300 lb. per lin. ft. of tie. These assumptions as to loading produce theoretical stresses of approximately 1100 lb. per sq. in. compression in the concrete, 17,000 lb. per sq. in. in the tensile steel and about 7000 lb. per sq. in. in the compression steel. The unit shearing stress in the concrete under the rail is approximately 250 lb. per sq. in. The assumed loading is approximately equal to that produced by a Cooper E-60 locomotive with an allowance of 100% for impact.

In addition to the longitudinal and web reinforcement, the ties are provided with spirals with an inside diameter of 5¼ in. made of ¼-in. diameter rods on a 1-in. pitch which are installed around each spiking plug to increase the spike-holding power and to resist bursting pressure occasioned by driving the spike plug or swelling of the plug with the absorption of moisture.

The molds are of the gang type and each gang consists of approximately 100 molds. The bottom of the molds consists of a plank platform raised about 2 ft. from the earth floor of the building. The side forms or dividing plates are of steel and the end forms consist of wooden blocks. The ties are cast bottom side up. While the concrete is being placed the assembled "cages" of reinforcement are jiggled and the concrete worked into the molds by hand so as to secure thorough embedment of the bars.

Finishing is done with a handled wooden float immediately after which the entire gang of filled forms is covered with tarpaulins carried on a framework. The sides of the tarpaulin hang down to the floor enclosing the entire set of molds and steam is turned into the space under the tarpaulins through perforated steam pipes laid along the ground at each side of the platform. This "steam curing" is carried on for 24 hours, after which the ties are exposed to the air of the plant for another 24 hours and then handled in groups by a 5-ton overhead crane to cars for shipment. Thus the ties are shipped out 48 hours after casting.

The mix was worked out to produce concrete of 2500 lb. per sq. in. at 28 days with approximately a 4-in. slump and consists of one part cement, 1.8 parts sand and 2.4 parts gravel. The aggregate is obtained from the Allegheny river. Test cylinders show that at 48 hours after curing the concrete has attained a compressive strength from 900 to 1100 lb. per sq. in.

The mixer is a batch type of ½ cu. yd. capacity. The water is regulated by means of a tank equipped with a gage and a graduated scale, by means of which the amount of water used for each batch is easily controlled. The aggregate is supplied to the mixer from overhead bins and is measured in mechanical batchers.

The concrete is handled from the mixer by means of a 5-ton overhead crane. The mixer dumps directly into truncated cone-shaped buckets that are handled by the crane to proper place over the gang molds. In fact, all of the heavy work in the plant is done by this overhead crane.

Not only are all of the bars bent in the assembly room, but the wooden plugs are manufactured there also. The lumber for these plugs consists of 3-in. oak planks which are first ripped into blocks 3 in. square and then passed through a four-side sticker, thus producing pieces roughly octagonal. These pieces are then cut by a power saw to the required size and, after drying in a rack over a coke salamander, are dipped in creosote.

The capacity of the plant, including the assembling of the reinforcement, manufacture of plugs, placing of concrete and removal of the completed ties, is about 150 ties per day. The plant is operated by 30 men.

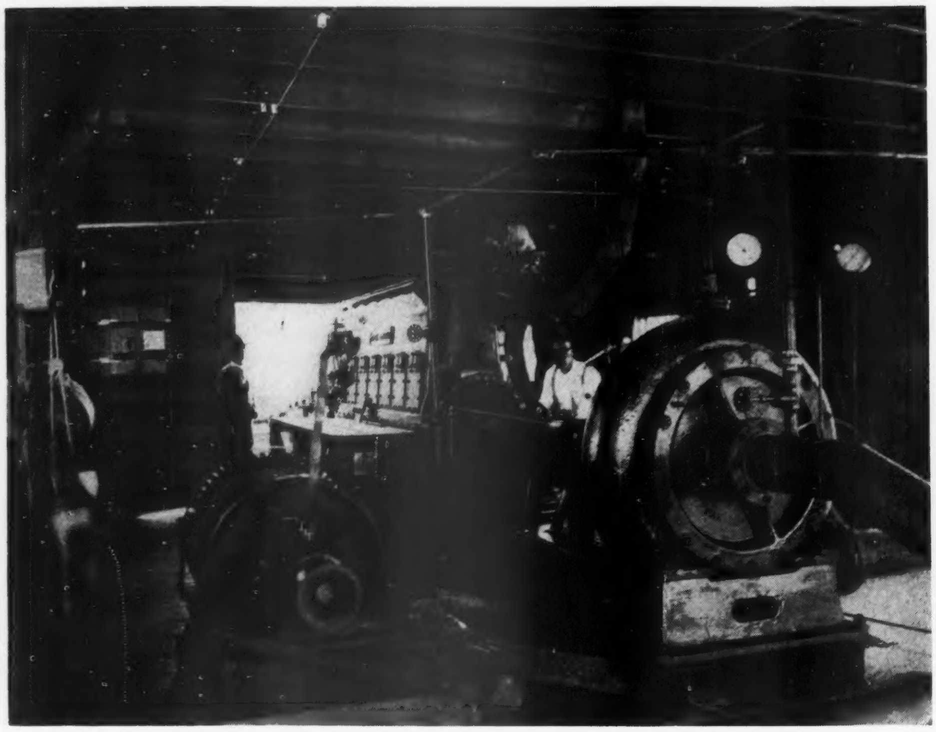
The work of manufacturing the ties was in progress during the winter and hence, in order to make it possible to ship ties in 48 hours, the water was heated to about 150 deg. F. and the aggregate also heated by means of steam coils in the overhead bins. The concrete was placed at a temperature of about 70 deg. F. and as soon as covered with tarpaulins the temperature was raised by means of live steam to about 90 deg.

Since these ties weigh approximately 600 lb., mechanical equipment for unloading and handling them is desirable. Unloading has been efficiently done with an ordinary air-hoist rail unloader. It is expected that similar equipment will be used to distribute the ties and that installation in place will be handled by power equipment. However, the tie is of such weight that it can be handled by five or six men.

Columbus Concrete Products Association Elects Officers

THE Columbus Concrete Products Association held its monthly meeting Monday night, May 6, at which time the annual election of officers took place. W. R. Steward, of Steward and Silver Concrete Block Co., was elected president; John Swickard, of the Lang Concrete Co., was voted vice-president, and G. M. Friel was unanimously re-elected secretary-treasurer.

The members agreed to change the meeting night from Monday to the first Thursday of each month, owing to other meetings falling on Monday night. It is hoped that this plan will encourage and stimulate better attendance at the products meetings. After the business meeting a light lunch was served, the arrangements for which were in charge of Harry Wellnitz.



Interior of the dredge operated by the Victory Sand and Stone Co., Topeka, Kan., on the Kansas river

Kansas River Gravel Shipped to Ohio

THE VICTORY SAND AND STONE CO., of Topeka, Kan., recently shipped a car of Kansas river gravel to Ivorydale, Ohio, where it will be used in a deep well at the Procter and Gamble Co. plant. The Procter and Gamble Co. is the manufacturer of Ivory soap.

"A particular quality of gravel was required, such as is found only in the virgin deposits in the Kansas river," Paul Sherman, president of the Victory company, explained. "This gravel was pumped 55 ft. below the bed of the river and is of a hard quartz and granite formation, specially adapted for filtration use.

"The well in which this gravel will be used is to be 279 ft. deep, with an outer casing of 48-in. perforated pipe. The gravel will be placed between this pipe and a second one 42 in. in diameter.

"The gravel in the Kansas river was laid down here during the glacial period of 300,000 years ago. Various sand companies have pumped up mastodon teeth and tusks. This is the first shipment of glacial gravel to be sent such a distance."

The Victory company was started a year ago and has grown to such proportions that it recently has added a fleet of Dodge Bros.' 4-yd. trucks and a Byers' master crane.

For pumping sand and gravel from the Kansas river bed the Victory Sand and Stone Co. uses an 8-in. Hetherington and Berner manganese-steel pump driven by a 6-cylinder, 4-cycle, Fulton Diesel engine of 200 hp. The engine is direct-connected to the pump by use of a twin disc clutch. A priming pump, hoists and air compressor are also operated from the pump and engine shaft. The accompanying illustration shows the interior of the dredge.

Louisiana to Set New Paving Record

LOUISIANA, whose voters last fall approved a highway bond issue of $30,000,000 and raised the gas tax from 2 to 4 cents a gallon, will shortly embark on that state's greatest road building season.

Plans call for the completion this year of some 800 miles of concrete pavement. This is considered a rather ambitious undertaking, but Leslie R. Ames, state highway engineer, is hopeful that this will be accomplished, provided a sufficient number of well equipped and responsible contractors can be obtained. Most contracts will be for 15 or 20 miles.

Immediate paving in Louisiana will be greatly facilitated by the good road beds now existing on state highways. Nearly all of the state highway system is either graded or gravel surfaced. Four main highways will be paved first. These include the Jefferson Highway and another North and South route, and two East and West roads, one of which is the Old Spanish Trail.

Plenty of aggregate is available for the construction work. There are now enough pits and quarries to supply materials for hard surfacing and a much greater annual mileage than is anticipated by the present extensive program.

By reason of Mr. Ames' wide highway building experience, particularly as chief highway engineer of North Carolina for several years, Louisiana will be enabled to start on a larger immediate program than would otherwise have been possible. Mr. Ames won nationwide recognition for large-scale pavement laying while in North Carolina. There he superintended the construction of several hundred miles of concrete yearly.

Pioneer Sand and Gravel Co. to Make Improvements

APPROXIMATELY $400,000 will be spent immediately by the Pioneer Sand and Gravel Co., Seattle, Wash., in development of its plants and construction of new bunkers, officials disclosed recently after an announcement that capitalization of the company had been increased from $2,000,000 to $3,000,000. Approximately half of the additional capital shares authorized will not be issued for the present, officials said.

The expenditure program provides $150,000 for expansion of the company's plant at the south end of Lake Union, $125,000 for its plants at the North End, $100,000 for new bunkers at 14th Avenue Northwest and the Lake Washington Canal, and a new bunker at the foot of First Avenue Northeast. Upon completion of the projects, the company will have five central concrete mixing plants instead of the three now in operation, officials said. The two new mixing plants will be at the north and south Lake Union holdings. Tremendous increase in the demand for the company's products and the new mode of mixing cement for construction purposes at a central plant instead of on the job after delivery of the ingredients account for the expansions, they added.—*Seattle* (Wash.) *Times.*

One Building in Chicago to Require 150,000 Cu. Yd. of Sand and Gravel

SHIPMENTS were started April 25 on one of the largest contracts for torpedo sand and gravel ever awarded in the Chicago district. The Aetna Sand and Gravel Co. reported it was making the first deliveries on 5,000 carloads, approximately 150,000 cu. yd. of sand and gravel bought by the John Griffiths and Son Co. for the superstructure concrete work on the Merchandise Mart project.

The entire tonnage called for in the contract will be shipped from the plant of the Aetna Sand and Gravel Co., at Algonquin, Ill., 40 miles from Chicago on the Chicago and North Western railroad. All shipments will be made over the railroad and officials of the company say that beginning the week of April 29 shipments on the contract will average 30 carloads a day. It will take all summer to complete delivery.—*Chicago* (Ill.) *Journal of Commerce.*

The Rock Products Market

Wholesale Prices of Crushed Stone

Prices given are per ton, F.O.B., at producing point or nearest shipping point

Crushed Limestone

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
EASTERN:						
Buffalo, N. Y.	1.30	1.30	1.30	1.30	1.30	1.30
Chaumont, N. Y.	.50	1.75	1.75	1.50	1.50	1.50
Chazy, N. Y.	.75	1.75	1.60	1.30	1.30	1.30
Dundas, Ont.	.53	1.05	1.05	.90	.90	.90
Farmington, Conn.		1.30	1.10	1.00	1.00	
Frederick, Mo.	.50– .75	1.35–1.45	1.15–1.25	1.10–1.20	1.05–1.15	1.05–1.10
Ft. Springs, W. Va.	.40	1.25	1.25	1.25	1.15	1.15
Munns, N. Y.	1.00	1.25	1.25	1.15	1.00	
Prospect, N. Y.	.80	1.15	1.15	1.15	1.15	
Rochester, N. Y.—Dolomite	1.50	1.50	1.50	1.50	1.50	1.50
St. Vincent de Paul, Que. (n)	.70	1.50	1.50	1.00–1.25	.95	.90
Syracuse, N. Y.	.50		1.00	1.00	1.00	1.00
Walford, Penn.			1.35h	1.35h	1.35h	1.35h
Watertown, N. Y.	1.00	1.75	1.75	1.50	1.50	1.50
Western New York	.85	1.25	1.25	1.25	1.25	1.25
CENTRAL:						
Afton, Mich.					.50	1.50
Alton, Ill.	1.85					
Columbia and Krause, Ill.	1.05–1.40	.95–1.50	1.15–1.50	1.05–1.50	1.05–1.50	
Cypress, Ill.	.90–1.15	.90–1.15	1.00–1.15	1.00–1.20	1.00–1.15	1.00
Davenport, Iowa (f)	1.00	1.50	1.50	1.30	1.30	1.40
Dubuque, Iowa	.95	1.00	1.00	1.10	1.10	1.00
Stolle and Falling Springs, Ill.	1.05–1.70	.95–1.70	1.15–1.70	1.05 1.70	1.05–1.70	
Greencastle, Ind.	1.25	1.05	1.05	1.05	1.05	1.05
Lannon, Wis.	1.00	1.00	1.00	.90	.90	.90
McCook, Ill.	1.00	1.25	1.25	1.25	1.25	1.25
Marblehead, Ohio (l)	.55	.80	.80	.80	.80	.80
Milltown, Ind.		.90–1.00	1.00–1.10	.90–1.00	.85– .90	.85– .90
Northern Ohio points	.85–1.15	1.25	1.15	1.15	1.15	1.15
Sheboygan, Wis.	1.10	1.10	1.10	1.10	1.10	1.10
Stone City, Iowa	.75		1.20	1.00	1.00	
Thornton, Ill.	.90	1.00	1.25	1.25	1.25	1.25
Toledo, Ohio	1.10	1.70	1.70	1.70	1.70	1.70
Toronto, Canada	2.50	3.00	3.00	2.85	2.85	2.85
Valmeyer, Ill. (fluxing limestone)	.90–1.20			1.75		1.75
Waukesha, Wis.		.90	.90	.90	.90	
Winona, Minn.	1.00	1.20	1.30	1.40	1.40	1.40
Wisconsin points	.50		1.00	.90	.90	
Youngstown, Ohio	1.00	1.00	1.25	1.25	1.25	1.25
SOUTHERN:						
Cartersville, Ga.	1.35	1.65	1.65	1.45	1.15	
Chico, Texas	.50	.50	1.25	1.15	1.10	1.00
Cutler, Fla.	.50– .75r			1.75r	1.10r	
El Paso, Tex.	.50–1.25r	1.00–1.50	1.00–1.75	1.00–1.75	1.00–1.75	
Graystone, Ala.	Crusher run, screened, $1 per ton					
Olive Hill, Ky.	1.00	1.00	1.00	1.00	.90	.90
Rocky Point, Va.	.50– .75	1.40–1.60	1.30–1.40	1.15–1.25	1.10–1.20	1.00–1.05
WESTERN:						
Atchison, Kan.	.50	1.80	1.80	1.80	1.80	1.80
Blue Springs and Wymore, Neb.	.25	1.45	1.45	1.35c	1.25d	1.20
Cape Girardeau, Mo.	1.00	1.25	1.25	1.25	1.00	
Rock Hill, St. Louis, Mo.	1.45	1.45	1.45	1.45	1.45	1.45

Crushed Trap Rock

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
Birdsboro, Penn. (q)	1.20	1.60	1.45	1.35		1.30
Branford, Conn.	.80	1.70	1.45	1.20	1.05	
Eastern Maryland	1.00	1.60	1.60	1.50	1.35	1.35
Eastern Massachusetts	.85	1.75	1.75	1.25	1.25	1.25
Eastern New York	.75	1.25	1.25	1.25	1.25	1.25
Eastern Pennsylvania	1.10	1.70	1.60	1.50	1.35	1.35
Knippa, Tex.	2.50	2.25	1.60	1.35	1.25	1.25–2.00
New Britain, Plainville, Rocky Hill, Wallingford, Meriden, Mt. Carmel, Conn.	.80	1.70	1.45	1.20	1.05	
Northern New Jersey	1.35–1.40	2.10	1.90	1.40–1.50	1.40–1.50	
Richmond, Calif.	.75		1.00	1.00	1.00	
Spring Valley, Calif.	.90–1.25	.90–1.25	.90–1.25	.90–1.25	.90–1.25	.90–1.25
Springfield, N. J.	1.40	2.00	1.90	1.60	1.60	
Toronto, Canada		5.80	4.05	4.05		
Westfield, Mass.	.60	1.35	1.25	1.10	1.00	1.00

Miscellaneous Crushed Stone

City or shipping point	Screenings, ¼ inch down	½ inch and less	¾ inch and less	1½ inch and less	2½ inch and less	3 inch and larger
Berlin, Utley, Montello and Red Granite, Wis.—Granite	1.80	1.70	1.50	1.40	1.40	
Cayce, S. C.—Granite			1.75	1.60	1.60	
Eastern Pennsylvania—Sandstone	1.35	1.70	1.65	1.40	1.40	1.40
Eastern Pennsylvania—Quartzite	1.20	1.35	1.25	1.20	1.20	1.20
Emathla, Fla.—Flint rock	1.00		2.35			
Lithonia, Ga.—Granite	.50a	1.75b	1.60	1.35	1.25	
Lohrville, Wis.—Granite	1.65	1.70	1.65	1.45	1.50	
Middlebrook, Mo.	3.00–3.50		2.00–2.25	2.00–2.25		1.25–3.00
Richmond, Calif.—Quartzite	.75		1.00	1.00	1.00	
Somerset, Penn. (sand-rock)	1.50 to 1.85					
Toccoa, Ga.—Granite		1.40	1.40	1.35	1.25	1.25

(a) Sand. (b) to ⅛ in. (c) 1 in., 1.40. (d) 2 in., 1.30. (e) Price net after 10c cash discount deducted. (f) High calcite fluxing limestone, 92–98% $CaCO$, 1.75. (g) Run of quarry. (h) Less 10c discount. (j) Less 10% net ton. (k) Rubble stone. (l) Less .05. (n) Ballast R. R., .90; run of crusher, 1.00. (p) Carloads prices. (q) Crusher run, 1.40; ¼-in. granolithic finish, 3.00. (r) Cubic yard.

Agricultural Limestone

(Pulverized)

Alton, Ill.—Analysis, 98% $CaCO_3$, 0.01% $MgCO_3$; 90% thru 100 mesh	4.00
Bettendorf and Moline, Ill.—Analysis, $CaCO_3$, 97%; 2% $MgCO_3$; 50% thru 100 mesh, 1.50; 50% thru 4 mesh	1.50
Blackwater, Mo.—100% thru 4 mesh	1.00
Branchton, Penn.—100% thru 20 mesh, 60% thru 100 mesh, 45% thru 200 mesh	a5.00
Cape Girardeau, Mo.—Analysis, $CaCO_3$, 94½%; $MgCO_3$, 3½%; 90% thru 50 mesh	1.50
Cartersville, Ga.—90% thru 100 mesh, 2.00; 50% thru 50 mesh	1.50
Chaumont, N. Y.—Pulverized limestone, bags, 4.00; bulk	2.50
Cypress, Ill. — Analysis, 95% $CaCO_3$, 2% $MgCO_3$; 90% thru 100 mesh, 1.35; 50% thru 100 mesh, 1.15; 90% thru 50 mesh, 1.15; 50% thru 50 mesh, 1.05; 90% thru 4 mesh, 1.10; 50% thru 4 mesh	1.00
Danbury, Conn., and West Stockbridge, Mass.—Analysis, 90% $CaCO_3$; 5% $MgCO_3$; fine ground, 90% thru 100 mesh; bulk	3.50
Paper bags	4.75
100-lb. cloth bags	5.25
(All prices less .25 cash 15 days)	
Davenport, Ia.—Analysis, 97% $CaCO_3$; 2% and less $MgCO_3$; 90% thru 200 mesh, bags, per ton	6.00
90% thru 20 mesh, bulk, per ton	1.50
Hillsville, Penn.—Analysis, 94% $CaCO_3$; 1.40% $MgCO_3$; 75% thru 100 mesh; sacked	5.00
Hot Springs and Greensboro, N. C.—Analysis, $CaCO_3$, 98-99%; $MgCO_3$, 42%; pulverized; 67% thru 200 mesh; bags	3.95
Bulk	2.70
Jamesville, N. Y.—Analysis, 89% $CaCO_3$, 4% $MgCO_3$; pulverized; bags, 4.25; bulk	2.75
Joliet, Ill.—Analysis, 52% $CaCO_3$; 48% $MgCO_3$; 90% thru 100 mesh	3.50
Knoxville, Tenn.—80% thru 100 mesh; bags, 3.95; bulk	2.70
Marlbrook, Va.—Analysis, 80% $CaCO_3$; 10% $MgCO_3$; bulk	1.75
Marl — Analysis, 95% $CaCO_3$; 0% $MgCO_3$; bulk	2.25
Marion, Va.—Analysis, 90% $CaCO_3$, 2% $MgCO_3$; per ton	2.00
Middlebury, Vt.—Analysis, 99.05% $CaCO_3$; 90% thru 50 mesh	4.25
Milltown, Ind.—Analysis, 94.50% $CaCO_3$, 33% thru 50 mesh, 40% thru 50 mesh; bulk	1.35–1.60
Olive Hill, Ky.—Analysis, $CaCO_3$ 94-98%; 50% & 90% thru 4 mesh	1.00
Piqua, Ohio—Total neutralizing power 101.12%; 60% thru 100 mesh	2.50
100% thru 10, 90% thru 50, 70% thru 100; bags, 5.00; bulk	3.50
100% thru 4, 30% thru 100, bulk	1.50
Rocky Point, Va. — Analysis, $CaCO_3$, 97%; $MgCO_3$, 75%; 50% thru 200 mesh, burlap bags, 3.50; paper, 3.25; bulk	2.00
Watertown, N. Y. — Analysis, 53.72% $CaCO_3$; pulverized; sacks, 4.25; bulk	2.75

(a) Less 50c comm. per ton.

Agricultural Limestone

(Crushed)

Bedford, Ind.—Analysis, 98% $CaCO_3$; 1%. $MgCO_3$; 90% thru 10 mesh	1.50
30% thru 100 mesh	1.50

(Continued on next page)

Agricultural Limestone

Chico and Bridgeport, Tex. — Analysis, 95% $CaCO_3$; 1.3% $MgCO_3$; 90% thru 4 mesh	1.00–1.25
Charles-Town, W. Va.—Lime Marl—Analysis, 95% $CaCO_3$, 50% thru 100 mesh, bulk, 3.00; including burlap bags	4.50
Davenport, Ia.—Analysis, 97% $CaCO_3$; 2% and less $MgCO_3$; 90% thru 10 mesh, per ton	1.25
90% thru 4 mesh, per ton	1.10
Dubuque, Iowa—Analysis, 54% $CaCO_3$; 38% $MgCO_3$; 90% thru 50 mesh	.95
Dundas, Ont.—Analysis, 54% $CaCO_3$; $MgCO_3$, 43%; 50% thru 50 mesh	1.00
Ft. Spring, W. Va. — Analysis, 90% $CaCO_3$; 50% thru 50 mesh	1.50
Kansas City, Mo.—50% thru 100 mesh	1.00
Lannon, Wis.—Analysis, 54% $CaCO_3$, 44% $MgCO_3$; 99% thru 10 mesh; 46% thru 60 mesh	2.00
Screenings (¼ in. to dust)	1.00
Marblehead, Ohio—90% thru 100 mesh	3.00
90% thru 50 mesh	2.00
90% thru 4 mesh	1.00
McCook, Ill.—90% thru 4 mesh	.95
Middlepoint, Bellevue, Bloomville, Kenton and Whitehouse, Ohio; Monroe, Mich.; Bluffton, Greencastle and Kokomo, Ind. —85% thru 10 mesh, 25% thru 100 mesh	1.50
Moline, Ill., and Bettendorf, Iowa—Analysis, 97% $CaCO_3$, 2% $MgCO_3$; 50% thru 100 mesh; 50% thru 4 mesh	1.50
Mountville, Va. — Analysis, 76.60% $CaCO_3$; $MgCO_3$, 22.83%, 100% thru 20 mesh; 50% thru 100 mesh, paper bags, 4.50; burlap bags	5.00
Stolle and Falling Springs, Ill.—Analysis, 89.9% $CaCO_3$, 3.8% $MgCO_3$; 90% thru 4 mesh	1.15–1.70
Stone City, Iowa — Analysis, 98% $CaCO_3$; 50% thru 50 mesh	.75
Waukesha, Wis.—90% thru 100 mesh, 4.50; 50% thru 100 mesh	2.10
Valmeyer, Ill.—Analysis, 96% $CaCO_3$, 2% $MgCO_3$; 100% thru 10 mesh	1.10–1.70

Pulverized Limestone for Coal Operators

Davenport, Ia.—Analysis 97% $CaCO_3$; 2% and less $MgCO_3$; 100% thru 20 mesh, 50% thru 200 mesh; paper sacks	6.00
Hillsville, Penn., sacks, 5.10; bulk	3.50
Joliet, Ill.—Analysis, 52% $CaCO_3$; 48% $MgCO_3$; 95% thru 100 mesh; paper bags (bags extra)	3.50
Marblehead, Ohio — Analysis, 83.54% $CaCO_3$; 14.92% $MgCO_3$; 99.8% thru 100 mesh; sacks	4.25
Piqua, Ohio—99% thru 100 mesh, bulk, 3.50; in 80-lb. bags (f.o.b. Piqua)	5.00
Rocky Point, Va.—Analysis, 97% $CaCO_3$; 75% $MgCO_3$; 85% thru 200 mesh, bulk	2.25–3.50
Waukesha, Wis.—90% thru 100 mesh, bulk	4.00

Glass Sand

Silica sand is quoted washed, dried and screened unless otherwise stated. Prices per ton f.o.b. producing plant.

Cedarville and S. Vineland, N. J.	*1.75–2.25
Cheshire, Mass., in carload lots	5.00–7.00
Estill Springs and Sewanee, Tenn.	1.50
Franklin, Penn.	2.00
Klondike, Mo.	2.00
Massillon, Ohio	3.00
Michigan City, Ind.	.30– .35
Ohlton, Ohio	2.50
Ottawa, Ill.	1.25
Red Wing, Minn.	1.50
San Francisco, Calif.	4.00–5.00
Silica and Mendota, Va.	2.00
St. Louis, Mo.	2.00
Utica and Ottawa, Ill.	.75–1.00
Zanesville, Ohio	2.50

Miscellaneous Sands

City or shipping point	Roofing sand	Traction
Beach City, Ohio		1.50
Dresden, Ohio		1.25
Eau Claire, Wis.	4.30	1.00–1.25
Estill Springs and Sewanee, Tenn.	1.35–1.50	1.35–1.50
Franklin, Penn.		1.75
Massillon, Ohio		2.00
Michigan City, Ind.		.30
Montoursville, Penn.		1.25
Ohlton, Ohio	1.75	1.75
Ottawa, Ill.	3.25	1.25
Red Wing, Minn.		1.00
San Francisco, Calif.	3.50	3.50
Silica, Va.		1.75

(Continued on next page)

Wholesale Prices of Sand and Gravel

Prices given are per ton, F.O.B., producing plant or nearest shipping point

Washed Sand and Gravel

City or shipping point	Fine Sand, 1/10 in. down	Sand, ¼ in. and less	Gravel, ½ in. and less	Gravel, 1 in. and less	Gravel, 1½ in. and less	Gravel, 2 in. and less
EASTERN:						
Asbury Park, Farmingdale, Spring Lake and Wayside, N. J.	.50	.50	1.15	1.25	1.25	
Attica and Franklinville, N. Y.	1.00	1.00	1.00	1.00	1.00	1.00
Boston, Mass.†	1.40	1.40	2.25		2.25	2.25
Buffalo, N. Y.	1.10	1.05	1.05	1.05	1.05	1.05
Erie, Penn.	.60	.85	1.30		1.30	
Leeds Junction, Me.		.50	1.75		1.25	1.00
Machias Jct., N. Y.	.75	.75	.75		.75	.75
Milton, N. H.		.50				.90
Montoursville, Penn.	1.00	.75	.80	.75	.70	.70
Northern New Jersey		.30– .50		.75–1.25	.75–1.25	
Somerset, Penn.		2.00				
South Portland, Me.		1.00	2.25			2.25
Troy, N. Y.	.50– .75*	.50– .75*	.80–1.00*	.80–1.00*		.80–1.00*
F. o. b. boat, per yd.	1.50	1.50	1.75	1.75		1.75
Washington, D. C.	.60	.60	1.20	1.20	1.00	1.00
CENTRAL:						
Algonquin, Ill.	.50	.35	.25	.45	.45	.50
Attica, Ind.	All sizes .75–.85					
Aurora, Moronts, Oregon. Sheridan, Yorkville, Ill.	.50	.35	.20	.50	.60	.60
Barton, Wis.		.40s	.65s	.65s	.65s	.65s
Chicago, Ill.	.50	.50–1.45n	.60	.60–1.55n	.60	.60–1.90r
Chicago, Ill.	.30	.20	.30	.40	.40	.45
Columbus, Ohio		.70‖	.70‖	.70‖	.70‖	
Des Moines, Iowa		.60	1.50	1.50	1.50	1.50
Eau Claire, Chippewa Falls, Wis.	.40	.40	.55	.85	.85	
Elkhart Lake, Wis.	.60	.30	.30	.50	.50	.50
Ferrysburg, Mich.		.50– .80	.60–1.00	.60–1.00		.50–1.25
Grand Haven, Mich.		.60		.90		.90
Grand Rapids, Mich.	.50	.50	.90	.80	.70	.70
Hamilton, Ohio		.60– .80	.60– .80		.60– .80	.60– .80
Hersey, Mich.		.50		.50	.70	.70
Humboldt, Iowa	.50	.50	1.40	1.40	1.40	1.40
Indianapolis, Ind.	.50– .60	.50– .60	.60– .75	.60– .75	.60– .75	.60– .75
Mankato, Minn.	.55	.45	1.25	1.25	1.25h	
Mason City, Iowa		.60	.85	1.25	1.25	1.25
Mattoon, Ill.	.75–.85 all sizes					
Milwaukee, Wis.	.91	.91	1.06	1.06	1.06	1.06
Minneapolis, Minn. (g)	.35	.35	1.25	1.25	1.25	1.25
St. Louis, Mo. (b)	1.30e	1.30f	1.55t	1.55	1.55	1.65
St. Louis, Mo.†	2.00e	2.00f	2.25t	2.25	2.25	2.35
St. Paul, Minn.	.35	.35		1.25	1.25	1.25
Terre Haute, Ind.	.75	.60	.75	.90	.75	.75
Waukesha, Wis.		.45	.60	.60	.65	.65
Winona, Minn.	.40	.40	.50	1.10	1.10	1.25
SOUTHERN:						
Brewster, Fla.	.50	.50				
Brookhaven, Miss.	1.25	.70	1.25	1.00	.70	.70
Charleston, W. Va.	River sand and gravel, all sizes, 1.40					
Eustis, Fla.		.50				
Ft. Worth, Texas	1.00–1.15	1.00–1.15	1.00–1.10	1.00–1.35	1.10–1.35	1.00–1.25
Knoxville, Tenn.	1.00	1.00	1.50	1.20	1.20	1.20
Macon, Ga.	.65– .90	.65– .90	2.25–2.50	2.25–2.50	2.25–2.50	2.25–2.50
New Martinsville, W. Va.	1.10	1.00		1.30	1.10	.90
Roseland, La.	.30	.30	1.00	1.00	.80	.80
WESTERN:						
Kansas City, Mo.	.70– .80	.70– .75				
Crushton, Durbin, Kincaid, Largo, Rivas, Calif.	.10– .40	.10– .40	.50–1.00	.50–1.00	.50–1.00	.50–1.00
Los Angeles, Calif.	.30	.30	.80	.80	.80	.80
Oregon City, Ore.	All grades range from 1.00 to 1.25 per cu. yd.					
Otay, Calif.		.35– .40	.50– .60	.50– .60	.50– .60	.50– .60
Phoenix, Ariz. (k)	1.25*	1.15*	1.50*	1.15*	1.15*	1.00*
Pueblo, Colo.	.70	.60		1.20		1.15
Seattle, Wash.	1.25*	1.25*	1.25*	1.25*	1.25*	1.25*
Steilacoom, Wash.	.50	.50	.50	.50	.50	.50

Bank Run Sand and Gravel

City or shipping point	Fine Sand, 1/10 in. down	Sand, ¼ in. and less	Gravel, ½ in. and less	Gravel, 1 in. and less	Gravel, 1½ in. and less	Gravel, 2 in. and less
Algonquin and Beloit, Wis.			.40			
Brookhaven, Miss.						.60
Buffalo, N. Y.	1.10	.95		.85		.35
Burnside, Conn.		.75*				
Chicago, Ill.	1.25m			.35		
Des Moines, Iowa		.75				
Dresden, Ohio				.70	.65	
Eau Claire, Chippewa Falls, Wis.					.65	
Fort Worth, Texas						.75–1.00
Gainesville, Tex.					.55	
Grand Rapids, Mich.				.50		
Hamilton, Ohio					.35– .50	
Hersey, Mich.				.50		
Indianapolis, Ind.	Mixed gravel for concrete work, at .65					
Macon, Ga.	.35					
Mankato, Minn.	.70					
Oregon City, Ore.	1.25*	1.25*	1.25*	1.25*	1.25*	1.25*
Roseland, La.				.60	.60	.60
Somerset, Penn.		1.85–2.00		1.50–1.75		
Steilacoom, Wash.	.25					
St. Louis, Mo.	Mine run gravel, 1.55 per ton					
Summit Grove, Ind.	.50	.50	.50	.50	.50	.54
Winona, Minn.						.60
York, Penn.	1.10	1.00				

*Cubic yd. †Delivered on job by truck. (a) ⅝-in. down. (b) 1½- to ¼-in., 1.65. (c) 2½-in. and less. ‖By truck only. (d) Delivered in Hartford, Conn., $1.50 per yd. (e) Mississippi River. (f) Meramee River. (g) Per yd., del. by truck, ¼-in. down, 1.25; 2 in. and less, 2.40. (h) ¾-in. and larger. (j) Lake sand, 1.75, delivered. (k) 60–70% crushed boulders. (m) Cu. yd., dune sand, f.o.b. cars, Chicago. (n) Cu. yd., f.o.b. cars, Chicago. (r) Pit run. (s) Plus 15c for winter loading. (t) Fine and regular binder. (u) Coarse, torpedo, also roofing. (v) Coarse binder. †2% discount if paid by 15th of month following delivery.

Core and Foundry Sands

Silica sand is quoted washed, dried and screened unless otherwise stated. Prices per ton f.o.b. producing plant.

City or shipping point	Molding, fine	Molding, coarse	Molding, brass	Core	Furnace lining	Sand blast	Stone sawing
Albany, N. Y.	2.00	2.00	2.25			3.75	3.00
Beach City, Ohio	1.75	1.75		1.50	1.50		
Cheshire, Mass.	Sand for soap, 7.00–8.00					6.00–8.00	
Dresden, Ohio	1.25–1.50	1.25–1.50	1.50–1.75	1.00 1.25			
Eau Claire, Wis.						3.00	
Elco and Murphysboro, Ill.	Water-floated ground silica per ton in carloads—18.00–31.00						
Estill Springs and Sewanee, Tenn.	1.25			1.25		1.35–1.50	
Franklin, Penn.	1.75	1.75		1.75			
Kasota, Minn.							1.00
Kerrs, Ohio	1.10–1.50	1.25–2.00	2.00			2.75–3.00	
Klondike, Mo.	2.00			2.00			
Massillon, Ohio	2.25	2.25		2.25	2.50		
Michigan City, Ind.				.30– .35			
Montoursville, Penn.				1.50–1.60			
New Lexington, Ohio	2.00	1.50					
Ohlton, Ohio	1.75	1.75		2.00	1.75	1.75	
Ottawa, Ill.	1.25	3.00	1.25	1.25	1.25	3.50	3.00
Red Wing, Minn. (d)					1.50	3.00	1.50
San Francisco, Calif.[1]	3.50†	5.00†	3.50†	3.50–5.00†	3.50–5.00†	3.50–5.00†	
Silica, Mendota, Va.	Potters sand, 8.00–10.00g						1.75
Utica and Ottawa, Ill.	.40–1.00f	.40–1.00f	.75–1.00	.40–1.00f	.60–1.00f	2.23–3.25	1.00–3.25
Utica, Ill.	.60	.70		.75	1.00		
Warwick, Ohio	1.50*–2.00h	1.50*–2.00h		1.50*–2.00h			
Zanesville, Ohio	2.00	1.50	2.00	2.50	2.00		

*Green. †Fresh water washed, steam dried. [1]Core, washed and dried, 2.50. (d) Filter sand, 3.00. (e) Filter sand, 3.00–4.25. (f) Crude and dry. (g) Also 12.00; building sand, 1.75–2.00. (h) Washed, 1.75.

Crushed Slag

City or shipping point	Roofing	¼ in. down	½ in. and less	¾ in. and less	1½ in. and less	2½ in. and less	3 in. and larger
EASTERN:							
Buffalo, N. Y., Erie and Dubois, Penn.	2.25	1.25	1.25	1.35	1.25	1.25	1.25
Eastern Penn.	2.50	1.20	1.50	1.20	1.20	1.20	1.20
Northern New Jersey	2.50	1.20	1.50	1.20	1.20	1.20	1.20
Reading, Penn.	2.50	1.25		1.50			
Western Pennsylvania	2.50	1.25	1.50	1.25	1.25	1.25	1.25
CENTRAL:							
Ironton, Ohio		1.30*		1.45*	1.45*	1.45*	
Jackson, Ohio	2.05*	1.05*	1.80*	1.30*	1.05*	1.30*	1.30*
Toledo, Ohio	1.50	1.10	1.25	1.25	1.25	1.25	1.25
SOUTHERN:							
Ashland, Ky.	2.05*	1.45*	1.80*	1.45*	1.45*	1.45*	1.45*
Ensley and Alabama City, Ala.	2.05	.55	1.25	1.15	.90	.90	.80
Longdale, Roanoke, Ruesens, Va.	2.50	1.00	1.25	1.25	1.25	1.15	1.05
Woodward, Ala.†	2.05	.55*		1.15*	.90*	.90*	

5c per ton discount on terms. †1¼ in. to ¼ in., $1.05; ⅝ in. to 10 mesh, $1.25*; ⅝ in. to 0 in., .90*; ¼ in. to 10 mesh, .80*.

Lime Products (Carload Prices Per Ton F.O.B. Shipping Point)

	Finishing hydrate	Masons' hydrate	Agricultural hydrate	Chemical hydrate	Ground burnt lime, Blk.	Ground burnt lime, Bags	Lump lime, Blk.	Lump lime, Bbl.
EASTERN:								
Berkeley, R. I.			12.00					2.00
Buffalo, N. Y.	11.50	7.50	7.50	12.00	8.00	11.00	7.50	1.50[10]
Lime Ridge, Penn.							5.00	
West Stockbridge, Mass.	12.00	10.00	5.60					2.00[12]
Williamsport, Penn.	10.00–11.00	8.50–9.00	8.50–9.00		7.00	9.00	5.00	
York, Penn., & Oranda, Va.	11.50[7]	8.50–9.50[7]	8.50–9.50[7]	8.50–10.50[7]	8.00	9.25	7.00	1.40[5]
CENTRAL:								
Afton, Mich.						10.00	7.50	
Carey, Ohio	11.50	7.50	7.50		8.00		7.50	1.50
Cold Springs, Ohio		7.50	7.50				8.00	
Gibsonburg, Ohio	11.50	7.50	7.50		8.00	10.00	8.00	
Huntington, Ind.	11.50	7.50	7.50	12.00	8.00	11.00	7.50	1.50[10]
Luckey, Ohio	11.50							
Milltown, Ind.		8.50–10.00		10.00[8]			8.50[22]	1.35[10]
Ohio points	11.50	7.50	7.50	12.00	8.00	11.00[23]	7.50	1.50[10]
Scioto, Ohio	11.50	7.50	7.50	8.50	8.25	.62½	7.00	1.50
Sheboygan, Wis.		10.50					9.50	2.00[4]
Wisconsin points[6]		11.50					9.50	
Woodville, Ohio	11.50	7.50	7.50	12.50	8.00	10.00[9]	8.00	1.50[8]
SOUTHERN:								
El Paso, Texas							7.00	1.50
Frederick, Md.		8.00–9.50	8.00–9.50			9.50[15]	7.00[16]	
Graystone & Landmark, Ala.	12.50	9.00		12.50	8.50		7.50	1.35
Keystone, Ala.		9.00	8.00	9.00	9.00	11.00	7.50	1.35
Knoxville, Tenn.		9.00	9.00	9.00	7.50	.62½	7.50	1.35
Ocala and Kendrick, Fla.		11.00		12.00				
WESTERN:								
Kirtland, N. M.							10.00	
Los Angeles, Calif.	15.00	14.00	12.00	18.00			13.50	
San Francisco, Calif.	19.00	17.50	13.00	17.50–19.00	14.50	.90[17]	14.50[19]	1.85[17]
Tehachapi, Calif.[18]	10.80		6.75[11]	12.00			10.30	
Seattle, Wash.	19.00	19.00	12.00	19.00	19.00		18.60	2.30

[1] Barrels. [2] Net ton. [3] Wooden, steel 1.70. [4] Steel; in bbl. .95. [5] Dealers' prices, net 30 days less 25c discount per ton on hydrated lime and 5c per bbl. on lump if paid in 10 days. [7] In paper bags, including bags. [8] To 11.00. [9] 80-lb. [10] In bags. [11] Refuse or air slack, 10.00–12.00. [12] To 3.00. [13] Delivered in Southern California. [15] To 8.00. [16] To 1.70. [17] Less credit for return of empties. [18] 90-lb. sacks. [19] To mortar plant and large industrials, 13.00. [22] To 9.00. [23] Per bbl., 2.15. [30] To 16.50.

Miscellaneous Sands

(Continued)

City or shipping point	Roofing sand	Traction
Utica and Ottawa, Ill.	1.00–3.25	.75
Warwick, Ohio		2.00
Zanesville, Ohio		2.50

*Damp.

Talc

Prices given are per ton f.o.b. (in carload lots only), producing plant, or nearest shipping point.

Chatsworth, Ga.:	
Crude talc, per ton	5.00–10.00
Ground talc (20-50 mesh), bags	7.00– 9.00
Ground talc (150-200 mesh), bags	10.00–12.00
Pencils and steel crayons, gross	1.50– 3.00
Chester, Vt.:	
Ground talc (150-200 mesh), paper bags	7.00– 8.00
Same, including 50-lb. bags	8.00– 9.00
Chicago and Joliet, Ill.:	
Ground (150-200 mesh), bags	30.00
Conowingo, Md.:	
Crude talc, bulk	4.00
Ground talc (150-200 mesh), in bags	14.00
Cubes, blanks, per lb.	.10
Dalton, Ga.:	
Crude talc (for grinding)	4.00
Ground talc (150-200 mesh), bags	9.00
Pencils and steel worker's crayons, per gross	1.00– 2.00
Emeryville, N. Y.:	
(Double air floated) including bags:	
200 mesh	13.75
325 mesh	14.75
Hailesboro, N. Y.:	
Ground talc (300-350 mesh) in 200-lb. bags	15.50–20.00
Henry, Va.:	
Crude (mine run)	3.50– 4.00
Ground talc (150-200 mesh), bags	6.25–10.50
Joliet, Ill.:	
Ground talc (200 mesh) in bags:	
California white	30.00
Southern white	20.00
Illinois talc	10.00
Crude talc	3.75
Keeler, Calif.:	
Ground (200-300 mesh), bags	20.00–30.00
Los Angeles, Calif.:	
Ground (200 mesh), in bags	14.00 25.00
Natural Bridge, N. Y.:	
Ground talc (300-325 mesh), bags	12.00–15.00

(a) Bags extra.

Rock Phosphate

Prices given are per ton (2240-lb.) f.o.b. producing plant or nearest shipping point.

Lump Rock

Columbia, Tenn.—B.P.L. 65-70%	3.50– 4.50
Gordonsburg, Tenn.—B.P.L. 68-70%	4.00– 4.50
Mt. Pleasant, Tenn.—B.P.L., 77%	6.50
Tennessee — F.o.b. mines, gross ton, unground brown rock, B.P.L. 72%	5.00
B.P.L. 75%	6.00
Twomey, Tenn.—B.P.L. 65%, 2000 lb.	8.00– 9.00

Ground Rock

(2000 lb.)

Centerville, Tenn.—B.P.L. 65%	8.00
Gordonsburg, Tenn.—B.P.L. 68%	3.50
B.P.L. 72%	4.50
Mt. Pleasant, Tenn.—Lime phosphate:	
B.P.L., 72.50%, 80% thru 300 mesh	11.70
B.P.L. 72%	5.50– 6.00
Twomey, Tenn.—B.P.L. 65%	8.00
Wales, Tenn.—B.P.L. 65%	11.00

Florida Phosphate

(Raw Land Pebble)

(Per Ton)

Florida—F.o.b. mines, gross ton, 68/66% B.P.L., Basis 68%	3.25
70% min. B.P.L., Basis 70%	3.75

Mica

Prices given are net, f.o.b. plant or nearest shipping point.

New York City, N. Y.—Per lb.,	
Cut mica (1½x2)	1.60
Cut mica (8x10)	26.00
Pringle, S. D.—Mine run, per ton	125.00
Punch mica, per lb.	.36
Scrap, per ton, carloads	20.00
Rumney Depot, N. H.—Per ton,	
Mine run	300.00
Clean shop scrap	25.00
Mine scrap	22.50–24.00
Roofing mica	37.50
Punch mica, per lb.	.12

Cut mica—50% from Standard List.

Special Aggregates

Prices are per ton f.o.b. quarry or nearest shipping point.

City or shipping point	Terrazzo	Stucco-chips
Brandon, Vt.—English pink, cream, and American Botticino, coral pink, pearl blush	¶12.50–‖14.50	¶12.50–‖14.50
Brighton, Tenn.—Pink marble chips	§3.00	§3.00
Crown Point, N. Y.—Mica spar	....	b9.00
Davenport, Ia.—White limestone, in bags	6.00	6.00
Easton, Penn.—Royal green	16.00–18.00a	....
Harrisonburg, Va. — Bulk marble (crushed, in bags)	12.50–14.00	12.50–14.00
Ingomar, Ohio — Concrete facings and stucco dash	....	11.00–18.00
Middlebrook, Mo.—Red	....	20.00–25.00
Middlebury, Vt. — Middlebury white	....	‖9.00–¶10.00
Middlebury and Brandon, Vt.—Caststone, per ton, including bags	....	5.50
Phillipsburg, N. J.—Royal green granite	....	15.00–18.00
Randville, Mich.—Crystalite white marble, bulk	4.00	4.00– 7.00
Stockton, Calif.—"Nat-rock" roofing grits	....	12.00–20.00
Tuckahoe, N. Y.—Tuckahoe white	8.00	....
Warren, N. H.	....	¶7.90–‖8.95
Wellsville, Colo.—Colorado Travertine Stone	15.00	15.00
Whitestone, Ga.	....	*10.00

†C.L.; L.C.L. 16.00. ¶C.L. ‖L.C.L. (a) Including bags. (b) In 100-lb. bags, car lots, min. car 20 tons. * Per 100 lb.

Potash Feldspar

Auburn and Topsham, Me.—Color white, 98% thru 140-mesh 19.00

DeKalb Jct., N. Y.—Color, white; analysis, K_2O, 2.11%; Na_2O, 6.86%; SiO_2, 74.04%; Fe_2O_3, .063%; Al_2O_3, 14.59%; pulverized, 100% thru 200 mesh, in bags, per ton, 22.00; bulk 20.00

Bedford Hills, N. Y.—Color, white; analysis, K_2O, 12.26%; Na_2O, 2.86%; SiO_2, 66.05%; Fe_2O_3, .08%; Al_2O_3, 18.89%; pulverized 78% thru 100 mesh, bulk, 11.00–14.00; crude, bulk, per ton 9.00

Trenton, N. J.—White; analysis, K_2O, 11%-13%; Na_2O, 1.5%-2.70%; SiO_2, 63%-67.80%; Fe_2O_3, .09%; Al_2O_3, 18.25%-20%; pulverized, 99.5% thru 200 mesh 20.00

Erwin, Tenn., and Spruce Pine, N. C. 16.00

Rochester, N. Y. 22.00

Los Angeles, Calif.—Color, white; analysis, K_2O, 12.16%; Na_2O, 1.53%; SiO_2, 65.60%; Fe_2O_3, .10%; Al_2O_3, 19.20%; Arizona spar, crude, bags, 12.50–14.00; bulk 11.00–12.50

Pulverized, 95% thru 200 mesh; bags, 19.73–23.50; bulk 15.75–22.50

Pulverized, 20% thru 80 mesh; bags, 17.60; bulk 16.50

Murphysboro, Ill.—Color, prime white; analysis, K_2O, 12.60%; Na_2O, 2.35%; SiO_2, 63%; Fe_2O_3, .06%; Al_2O_3, 18.20%; 98% thru 200 mesh; bags, 21.00; bulk 20.00

Penland, N. C.—White; crude, bulk 8.00

Ground, bulk 16.50

Spruce Pine, N. C.—Color, white; analysis, K_2O, 10%; Na_2O, 3%; SiO_2, 68%; Fe_2O_3, 0.10%; Al_2O_3, 18%; 99½% thru 200 mesh; pulverized, bulk, 18.00; crude, bulk 10.00

(Bags 15c extra.)

Tennessee Mills—Color, white; analysis, K_2O, 10%; Na_2O_3, 3%; SiO_2, 68%; 99½% thru 200 mesh; bulk (Bags, 15c extra) 18.00

Chicken Grits

Afton, Mich.—(Limestone), per ton 1.75

Belfast, Me.—(Limestone), per ton .... ‡10.00

Chico, Tex.—Hen size and Baby Chick, packed in 100-lb. sacks, per sack 1.00

Danbury, Conn.; Adams, Ashley Falls, and West Stockbridge, Mass.—(Limestone) .... ‡7.50–*9.00

Davenport, Ia.—(Limestone), bags, per ton 6.00

Easton, Penn.—In bags 8.00

El Paso, Tex.—Per ton 1.00

Knoxville, Tenn.—Per bag 1.25

Los Angeles, Calif.—Per ton, including sacks:

Feldspar 14.00

Gypsum 7.50– 9.50

Marion, Va.—(Limestone), bulk, 5.00; bagged, 6.50; 100-lb. bag .... .50

Middlebury, Vt.—Per ton (a) 10.00

Piqua, O. (b)—(Pearl Grit), fine and medium, per ton .... ¶8.00

Randville, Mich.—(Marble), bulk 6.00

Rocky Point, Va.—(Limestone), 100-lb. bags, 50c; sacks, per ton, 6.00; bulk 5.00

Seattle, Wash.—(Gypsum), bulk, per ton 10.00

Tuckahoe, N. Y. 8.00

Waukesha, Wis.—(Limestone), per ton 7.00

Wisconsin Points—(Limestone), per ton 15.00

Winona, Minn.—(Limestone), sacked, per ton, 8.00; bulk, per ton 6.00

*L.C.L. †Less than 5-ton lots. ‡C.L. ¶100-lb. bags. (a) F.o.b. Middlebury, Vt. (b) F.o.b. Piqua, Ohio.

Sand-Lime Brick

Prices given per 1000 brick f.o.b. plant or nearest shipping point, unless otherwise noted.

Albany, Ga.	11.00
Barton, Wis.	10.50g
Boston, Mass.	17.00*
Brighton, N. Y.	19.75*
Dayton, Ohio	12.50–13.50
Detroit, Mich. (h)	j13.00–16.00*d
Farmington, Conn.	13.00
Flint, Mich.	18.00†
Grand Rapids, Mich.	12.50
Hartford, Conn.	13.00–17.00*
Jackson, Mich.	13.00
Lakeland, Fla.	10.00–11.00
Lake Helen, Fla.	9.00–12.00
Lancaster, N. Y.	12.50
Madison, Wis.	12.50a
Mishawaka, Ind.	11.00
Milwaukee, Wis.	13.00*
Minneapolis, Minn.	10.00
New Brighton, Minn.	12.75
Pontiac, Mich.	12.50
Portage, Wis.	15.00
Prairie du Chien, Wis.	18.00–22.50
Rochester, N. Y.	19.75
Saginaw, Mich.	13.50
San Antonio, Texas	12.50
Sebewaing, Mich.	12.50
Sioux Falls, S. Dak.	13.00
South River, N. J.	13.00
South St. Paul, Minn.	9.00
Syracuse, N. Y.	18.00–20.00
Toronto, Canada (f)	15.00†e
Wilkinson, Fla.	12.00–16.00
Winnipeg, Canada	15.00

*Delivered on job. †5% disc. 10 days. ‖Dealers' price. (a) Less 50c disc. per M, 10th of month. (d) 5% disc., 10th of month. (e) Delivered. (f) In yard, 12.50. (g) Delivered Milwaukee, 13.00. (h) Also 15.50. (j) Also 14.00.

Portland Cement

	Per Bag	Per Bbl.	High Early Strength
Atlanta, Ga.	....	2.36	3.51¶
Baltimore, Md.	....	2.25–2.65	3.55¶
Birmingham, Ala.	....	2.00	3.44¶
Boston, Mass. (g)	.68¼	2.23–2.73e	3.27¶
Buffalo, N. Y.	.62½	2.10†	3.40¶
Butte, Mont.	.90¼	3.61	......
Cedar Rapids, Iowa	....	2.24	
Charleston, S. C.	....	2.25–2.65d	3.58¶
Cheyenne, Wyo.	.64	2.56	
Chicago, Ill.	....	2.05–2.45	3.35¶
Cincinnati, Ohio	....	2.22–2.62	3.52¶
Cleveland, Ohio	....	2.24–2.64	3.54¶
Columbus, Ohio	....	2.22–2.62	3.52¶
Dallas, Texas	....	1.80	3.39¶
Davenport, Iowa	....	2.24	
Dayton, Ohio	....	2.22–2.64	3.54¶
Denver, Colo.	.63¾	2.55	......
Des Moines, Iowa	....	2.14	
Detroit, Mich.	....	1.95–2.35	3.27¶
Duluth, Minn.	....	2.04	
Houston, Texas	....	1.90	3.63¶
Indianapolis, Ind.	.54¾	2.09–2.49	3.39¶
Jackson, Miss.	....	2.04–2.44	3.53¶
Jacksonville, Fla.	....	2.60b	3.79¶
Jersey City, N. J.	....	2.13–2.53	3.43¶
Kansas City, Mo.	.45½	1.82	3.22¶
Los Angeles, Calif.	.51½	2.06	
Louisville, Ky.	.55½	2.57	3.47¶
Memphis, Tenn.	....	2.04–2.44	3.34¶
Milwaukee, Wis.	....	2.20–2.60	3.50¶
Minneapolis, Minn.	....	2.12–2.22	......
Montreal, Que.	....	1.60	
New Orleans, La.	.45½	1.82	3.72¶
New York, N. Y.	.60¾	1.93–2.43	3.33¶
Norfolk, Va.	....	1.97	3.27¶
Oklahoma City, Okla.	.57¼	2.29	3.69¶
Omaha, Neb.	.54	2.16	3.56¶
Peoria, Ill.	....	2.22	
Pittsburgh, Penn.	....	2.05–2.44	3.35¶
Phoenix, Ariz.	....	3.91*	......
Portland, Ore.‡	....	2.40–2.90a	......
Reno, Nev.‡	....	2.91–3.41a	......
Richmond, Va.	....	2.32–2.72	3.62¶
Salt Lake City, Utah	.70¼	2.81	......
San Francisco, Calif.‡	....	2.21–2.71a	......
Savannah, Ga.	....	2.60c	3.65¶
St. Louis, Mo.	.48¾	1.95–2.35	f3.25¶
St. Paul, Minn.	....	2.12–2.22	......
Seattle, Wash.	....	†2.50–2.65j	f3.50†
Tampa, Fla.	....	2.40	4.08¶
Toledo, Ohio	....	2.20–2.60	3.50¶
Topeka, Kans.	.50¼	2.01	3.41¶
Tulsa, Okla.	.53¼	2.13	3.53¶
Wheeling, W. Va.	....	2.12–2.52	3.42¶
Winston-Salem, N. C.	....	2.29–2.69	3.59¶

Mill prices f.o.b. in carload lots, without bags, to contractors.

	Per Bag	Per Bbl.	High Early Strength
Albany, N. Y.	.43¾	1.75	......
Bellingham, Wash.	....	2.10	......
Buffington, Ind.	....	1.80	......
Chattanooga, Tenn.	....	2.45*	......
Concrete, Wash.	....	2.35	......
Davenport, Calif.	....	2.05	......
Hannibal, Mo.	....	1.90	......
Hudson, N. Y.	....	1.75	......
Leeds, Ala.	....	1.65	......
Lime and Oswego, Ore.	....	2.50‡	......
Mildred, Kan.	....	2.35	......
Nazareth, Penn.	....	2.15	......
Northampton, Penn.	....	1.75	......
Richard City, Tenn.	....	2.05	......
Toledo, Ohio	....	2.20	......
Universal, Penn.	....	1.80	......

NOTE—Add 40c per bbl. for bags. *Includes sacks. †10c disc., 10 days. ‡10c disc., 15 days. (a) Includes cloth sacks returnable at 10c each. (b) 24c bbl. refund for paid freight bill. (c) 35c bbl. refund for paid freight bill. (d) 40c bbl. refund for paid freight bill. (e) 45c bbl. foreign refund. (i) "Velo" cement, including cost of paper bag. ¶ "Incor" Perfected prices per bbl. packed in paper sacks, subject to 10c disc. 15 days. (g) Also 2.33 per bbl. (j) 25c bbl. disc. 10 days.

Gypsum Products— CARLOAD PRICES PER TON AND PER M SQUARE FEET, F.O.B. MILL

	Crushed Rock	Ground Gypsum	Agricultural Gypsum	Stucco Calcined Gypsum	Cement and Gaging Plaster	Wood Fiber	Gaging White	Plaster Sanded	Cement Keene's	Finish Trowel	Plaster Board ⅜x32x36". Per M Sq. Ft.	Plaster Board ½x32x36". Per M Sq. Ft.	Wallboard, ⅜x32 or 48" Lengths 6'-10'. Per M Sq. Ft.
Acme, Tex.	1.50–3.00	4.00	4.00	4.00–6.00	4.00–6.00	4.00–6.00	10.00	10.00	19.00	19.00	10.50	10.50	12.00
Blue Rapids, Kan.	1.50–3.00	4.00	4.00	4.00–6.00	4.00–6.00	4.00–6.00	10.00	10.00	19.00	19.00	10.50	10.50	12.00
Delawanna, N. J.	....	....	....	4.50–5.00	13.10–14.00	5.00	....	7.25	....	....	....	....	25.00
East St. Louis, Ill.	Special Gypsum Products—Interior partition section, 4 in. wide. 12 in. thick and up to 10 ft. 6 in. long, per ton, 21.00; 6x6 in. and up to 10 ft. 6 in. long, per ton, 30.00; floor section, 7x16 in. and up to 13 ft. 6 in. long, per ton, 23.00.												
Ft. Dodge, Iowa; N. Holston, Va.; Akron, N. Y.	1.50–3.00	4.00	4.00	4.00–6.00	4.00–6.00	4.00–6.00	10.00	10.00	19.00	19.00	10.50	10.50	12.00
Grand Rapids, Mich.	1.50–3.00	4.00	4.00	4.00–6.00	4.00–6.00	4.00–6.00	10.00	10.00	19.00	19.00	10.50	10.50	12.00
Gypsum, Ohio	1.70–3.00	4.00	6.00	7.00–9.00	9.00	9.00	19.00	7.00	24.50	19.00	....	15.00	20.00–25.00
Los Angeles, Calif. (f)	....	7.50–9.50	7.50–9.50	8.50–10.00	9.00–11.00	....	9.00–11.00	....	29.00–34.00	....	....	....	....
Medicine Lodge, Kan.	....	....	....	....	....	....	....	....	15.00	....	....	....	....
Oakfield, N. Y.	2.50	....	....	5.50	6.00	6.00	....	5.50	....	....	....	15.00	25.00
Port Clinton, Ohio	3.00	4.00	6.00	10.00	9.00	9.00	21.00	7.00	30.15	20.00	....	20.00	30.00
Providence, R. I. (x)	....	....	....	12.00–13.00o	....	....	....	....	....	....	Partition block, solid reinforced, 12x30x3", 7c per sq. ft. in truck lots		
San Francisco, Calif.	....	....	9.00	13.40	14.40	....	15.40	....	....	....	....	....	....
Seattle, Wash.	....	10.00m	10.00m	13.00m	....	....	14.00	....	23.00	....	....	....	....
Winnipeg, Man.	5.00	4.90	7.00	13.00	14.00	14.00	....	....	....	....	20.00w	....	33.00

NOTE—Returnable bags. 10c each; paper bags, 1.00 per ton extra (not returnable. (a) Hardwall plaster, 13.00; casting, finishing molding, 14.00; (b) Cal-acoustic plaster, 10.00 at mill; (c) Plaster lath; (d) ¼x48x36 in.; (f) plasterboard, 18c to 20c per yd.; (m) includes paper bags; (o) includes jute sacks; (u) includes sacks; (v) retail, 35.00; (w) 16x48; (x) 2- and 3-in. "Fabricaste" gypsum blocks, 6–7c per sq. ft.

Market Prices of Cement Products and Slate

Concrete Block

Prices given are net per unit, f.o.b. plant or nearest shipping point.

City or shipping point	Size 8x8x16
Camden, N. J.	17.00
Cement City, Mich.	55.00¶
Chicago District‖	180.00–210.00a
8x10x16	230.00–260.00a
8x12x16	280.00–330.00a
Columbus, Ohio	15.00c– 17.00†
Detroit, Mich. (d)	.15– .17†
Forest Park, Ill.	21.00*
Grand Rapids, Mich.	11.00*
Graettinger, Iowa	.18– .20
Indianapolis, Ind.	.10– .12a
Los Angeles, Calif.	4x8x12-5.00*
Olivia and Mankato, Minn.	9.50b
Somerset, Penn.	.18– .20
Tiskilwa, Ill.	.16– .18†
Yakima, Wash.	20.00*

*Price per 100 at plant. †Rock or panel face. ‡Delivered. ¶5x8x12, 55.00 per 1000. (a) Face. (b) Per ton. (c) Plain. (d) 8x12x16, rock or panel face, .24–.26.

Cement Building Tile

Cement City, Mich.:	
5x8x12, per 100	5.00
Chicago District (Haydite):	
4x 8x16, per 100	13.00
8x 8x16, per 100	20.00
8x12x16, per 100	28.00
Columbus, Ohio:	
5x8x12, per 100	6.50
Detroit, Mich.:	
5½x8x12, per M	75.00
Grand Rapids, Mich.:	
5x8x12, per 100	6.00
Longview, Wash.:	
4x6x12, per 100	5.00
4x8x12, per 100	6.25
Mt. Pleasant, N. Y.:	
5x8x12, per M	78.00
Houston, Texas:	
5x8x12 (Lightweight), per M	80.00

Cement Roofing Tile

Prices are net per square, carload lots, f.o.b. nearest shipping point, unless otherwise stated.

Camden and Trenton, N. J.—8x12, per sq.:	
Red	15.00
Green	18.00
Cicero, Ill.—French and Spanish tile (red, orange, choc., yellow, tan, slate, gray) per sq., 9.50-10.00; green or blue, per sq.	11.50-12.00
Detroit, Mich.—5x8x12, per M	67.50
Houston, Texas—Roofing Tile, per sq.	25.00
Indianapolis, Ind.—9x15-in.	Per sq.
Gray	10.00
Red	11.00
Green	13.00
Wildasin Spur, Los Angeles, Calif. (Stone-Tile):	
3½x6x12, per M	50.00
3½x8x12, per M	60.00
Prairie du Chien, Wis.:	
5x8x12, per M	82.00
5x4x12, per M	46.00
5x8x6 (half-tile), per M	41.00
5x8x10 (fractional), per M	82.00
Yakima, Wash. (Building Tile):	Each
5x8x12	.10

Concrete Brick

Prices given per 1000 brick, f.o.b. plant or nearest shipping point.

	Common	Face
Appleton, Minn.	22.00	25.00– 40.00
Baltimore, Md. (Del. according to quantity)	15.50	22.00– 50.00
Camden & Trenton, N. J.	17.00	
Chicago District "Haydite"	14.00	
Columbus, Ohio	16.00	17.00
El Paso, Tex.—Klinker	10.00	
Ensley, Ala. ("Slagtex")	12.50	
Eugene, Ore.	25.00	35.00– 75.00
Forest Park, Ill.		37.00
Friesland, Wis.	22.00	32.00
Longview, Wash.*	15.00	22.50– 65.00
Los Angeles, Calif.	12.50	
Milwaukee, Wis.	14.00	40.00
Mt. Pleasant, N. Y.		14.00– 23.00
Omaha, Neb.	18.00	30.00– 40.00
Pasadena, Calif.	10.00	
Philadelphia, Penn.	15.50	17.50
Portland, Ore.	17.50	23.00– 55.00
Mantel brick—100.00–150.00		
Prairie du Chien, Wis.	14.00	22.00– 25.00
Rapid City, S. D.	18.00	30.00– 40.00
Waco, Texas	16.50	32.50–125.00
Watertown, N. Y.	20.00	35.00
Westmoreland Wharves, Penn.	14.75	20.00
Winnipeg, Man.	14.00	22.00
Yakima, Wash.	22.50	

*40% off List.

Stone-Tile Hollow Brick

Prices are net per thousand f.o.b. plant.

	No. 4	No. 6	No. 8
Albany, N. Y.*†	40.00	60.00	70.00
Asheville, N. C.	35.00	50.00	60.00
Atlanta, Ga.	26.50	45.00	53.00
Brownsville, Tex.		53.00	62.50
Brunswick, Me.†	40.00	60.00	80.00
Charlotte, N. C.	35.00	45.00	60.00
De Land, Fla.	30.00	50.00	60.00
Farmingdale, N. Y.	37.50	50.00	60.00
Houston, Tex.	35.00	45.00	60.00
Jackson, Miss.	45.00	55.00	65.00
Klamath Falls, Ore.	65.00	75.00	85.00
Longview, Wash.		55.00	64.00
Los Angeles, Calif.	29.00	39.00	45.00
Mattituck, N. Y.	45.00	55.00	65.00
Medford, Ore.	50.00	55.00	70.00
Memphis, Tenn.	50.00	55.00	65.00
Mineola, N. Y.	45.00	50.00	60.00
Nashville, Tenn.	30.00	49.00	57.00
New Orleans, La.	35.00	45.00	60.00
Norfolk, Va.	35.00	50.00	65.00
Passaic, N. J.	35.00	50.00	65.00
Patchogue, N. Y.		60.00	70.00
Pawtucket, R. I.	35.00	55.00	75.00
Safford, Ariz.	32.50	48.75	65.00
Salem, Mass.	40.00	60.00	75.00
San Antonio, Tex.	37.00	46.00	60.00
San Diego, Calif.	35.00	44.00	52.50

Prices are for standard sizes—No. 4, size 3½x4x12 in.; No. 6, size 3½x6x12 in.; No. 8, size 3½x8x12 in. *Delivered on job. †10% disc.

Wholesale Prices of Slate

Prices given are f.o.b. at producing point or nearest shipping point

Slate Flour

Pen Argyl, Penn.—Screened 200 mesh (96% thru 300 mesh), $7.00 per ton in paper bags.

Slate Granules

Esmont, Va.—Blue, $7.50 per ton. Granville, N. Y.—Red, green and black, $7.50 per ton.
Pen Argyl, Penn.—Blue-grey, bulk, $6.00 per ton (10c additional per 150-lb. bag).

Roofing Slate

Prices per square—Standard thickness.

City or shipping point:	3/16-in.	¼-in.	⅜-in.	½-in.	¾-in.	1-in.
Arvonia, Va.—Oxford gray Buckingham	14.62	18.13	23.40	26.33	32.14	40.95
Bangor, Penn.—No. 1 clear	10.50–14.50	24.50	29.00	33.50	44.50	55.60
No. 1 ribbon	9.00–10.25	20.00	24.50	29.00	40.00	51.25
Gen. mediums	9.50–11.25					
No. 2 ribbon	6.75– 7.25					
No. 1 Albion clear	7.25–10.50	16.00	23.00	27.00	37.00	46.00
Albion mediums	8.00– 9.00					
Chapman Quarries, Penn.—No. 1	8.50–11.25					
Medium	7.75– 9.00					
Hard vein		16.00	23.00	26.00	32.00	40.00
Granville, N. Y.—Sea green, weathering	14.00	24.00	30.00	36.00	48.00	60.00
Semi-weathering, green and gray	15.40	24.00	30.00	36.00	48.00	60.00
Mottled purple and unfading green	21.00	24.00	30.00	36.00	48.00	60.00
Red	27.50	33.50	40.00	47.50	62.50	77.50
Monson, Maine	19.80	24.00				
Pen Argyl, Penn.*						
Graduated slate (blue)		16.00	23.00	27.00	37.00	46.00
Graduated slate (grey)		18.00	25.00	29.00	39.00	48.00
Color-tone	11.50–12.50; Vari-tone, 12.00–13.00; Cathedral gray, 14.00–15.00					
No. 1 clear (smooth text)	7.25–10.50; No. 1 clear (rough text), 8.25–9.50					
Albion-Bangor medium	8.00–9.00; No. 2 clear, 8.00–9.00; No. 1 ribbon, 8.00–8.50					
Slatedale and Slatington, Penn.—						
Genuine Franklin	11.25	22.00	26.00	30.00	40.00	50.00
Blue Mountain No. 1	10.50	22.00	26.00	30.00	40.00	50.00
Blue Mountain No. 1 clear	9.50	18.00	22.00	26.00	36.00	46.00
Blue Mountain No. 2 clear	8.00	18.00	22.00	26.00	36.00	46.00

(a) Prices are for standard preferred sizes (standard 3/16-in. slates), smaller sizes sell for lower prices.
(b) Prices other than 3/16-in. thickness include nail holes.
(c) Prices for punching nail holes, in standard thickness slates, vary from 50c to $1.25 per square.
*10% discount to roofer; 10%–8⅓% to wholesaler.

Cement Drain Tile

Graettinger, Iowa.—Drain tile, per foot: 5-in., .04½; 6-in., .05½; 8-in., .09; 10-in., .12½; 12-in., .17½; 15-in., .35; 18-in., .50; 20-in., .60; 24-in., 1.00; 30-in., 1.35; 36-in.	2.00
Longview, Wash.—Drain tile, per foot: 3-in., .05; 4-in., .06; 6-in., .10; 8-in., .15; 10-in.	.20
Olivia and Mankato, Minn.—Cement drain tile, per ton	8.00
Tacoma, Wash.—Drain tile, per 100 ft.	
3-in.	4.00
4-in.	5.00
6-in.	7.50
8-in.	10.00
Waukesha, Wis.—Drain tile, per ton	8.00

Current Prices Cement Pipe

Prices are net per foot f.o.b. cities or nearest shipping point in carload lots unless otherwise not d

Culvert and Sewer	4 in.	6 in.	8-in.	10 in.	12 in.	15-in.	18 in.	20 in.	22 in.	24 in.	27 in.	30 in.	36 in.	42 in.	48 in.	54 in.	60 in.
Detroit, Mich. (c)																	
Sewer	.10	.12	.22	.30	.40	.60	.90	1.20		1.75	2.00	2.50	3.30	4.50	5.75	6.50	8.00
Culvert					.95	1.25	1.60			2.25	2.50	3.00	3.50	5.00	6.50	8.00	10.00
Grand Rapids, Mich. (b)				.60	.70	.90	1.20			1.80	2.10	2.35	3.50	4.00	5.60	6.90	7.85
Houston, Texas		.19	.28	.43	.55½	.90	1.30		1.70†	2.20							
Indianapolis, Ind. (a)				.75	.85	.90	1.15			1.60		2.50					
Mankato, Minn. (b)										1.50	1.75	2.50	3.25	4.25			
Newark, N. J.	6 in. to 24 in., 18.00 per ton																
Norfolk, Neb. (b)				.90	1.00	1.13	1.42			2.11		2.75	3.58		6.14		7.78
Paullina, Iowa‡								2.25		2.11		2.75	3.58		6.14		7.78
Somerset, Penn.					1.08	1.25	1.65			2.50		3.65	4.85	7.50	8.50		
Tiskilwa, Ill. (rein.)				.75	.85	.95	.70	1.55									
Tacoma, Wash.	.15	.17	.22	.30	.40	.55	75										
Wahoo, Neb. (b)					.85½		114			1.81		2.47	3.42	4.13	5.63	6.49	7.31
Yakima, Wash.							1.42			2.11		2.75	3.58	4.62	6.14	6.96	7.78

(a) 24-in. lengths. (b) Reinforced (c) Delivered on job; 5% discount, 10th of month. †21-in. diameter. ‡Price per 2-ft. length.

Insulation Resistance Measurements on Cement Mill Equipment

A "2-in-1" "Standco Megohmer" furnished by Herman H. Sticht & Co., of New York, has given satisfactory results at the plant of the Lawrence Portland Cement Co., for the past five years. Insulation resistance testing is done on regular bi-weekly and quarterly schedules. This not only serves to hold down the insurance rates on the plant's most important key machines but also minimizes the danger of costly production tie-ups which would impose heavy loss directly on the plant in cases where machines are not insured.

The testing cost is considered insignificant in comparison with the possible cost of shut-downs avoided as a result of tests. A single insulation failure on any one of several machines might easily cost the plant more in repair and lost time charges than the entire purchase price of the "Megohmer."

Electrical Equipment

Power is brought to the plant over 66-kv. lines and is stepped down to 2300 volts with two 7,000-kva. transformers. Three motor-generator sets with a total capacity of 800 kw. generate power for a 250-volt d.-c. power circuit. There are approximately 430 motors in use in the plant, ranging from fractional horsepower to 450-hp. size. Practically all a.-c. motors over 50-hp. are supplied with 2,300-volt power while the smaller ones are run from the 440-volt lines. A total of about 30 transformers of various sizes are in use throughout the plant.

Practically all of the wiring is done with lead-covered cable run in conduits and circuit insulation trouble is therefore rare. The plant operates two electrically-driven shovels, however, each containing eleven motors for which d.-c. power must be supplied through flexible cables.

Megohmer Applications

All of the equipment in the plant is gone over once every three months and any case in which insulation resistance is less than one-half megohm is immediately investigated. Measurements are made while the insulation is hot, from the conductors to ground and also from conductor to conductor.

Due to the fact that the plant is equipped with practically new electrical equipment throughout, because of a recent change from 25-to 60-cycle power, there is little insulation trouble with the motors. Before the change-over was made, however, a number of motors showed weak insulation whenever a test was made. These motors were repaired promptly at times when there would be no loss of productive time and it was considered more economical to repair weak insulation than to rewind motor fields or armatures after a complete insulation failure had forced the motor out of service.

In addition to the tests every three months, shovel motors and other equipment which receives especially hard service are tested every second week. On the shovels this is made necessary because of the vibration and by the fact that oil cannot be kept off of the wiring. Both of the shovels and some other equipment are insured against break down and the insurance company has a representative call frequently to make checks of insulation resistance. Should the insurance inspector find the resistance low or the equipment not well taken care of there is no doubt but that the insurance rates on this equipment would be raised.

On one or two occasions motors have become flooded, requiring a thorough bake-out before they could safely be returned to service. In each of these cases the Megohmer was almost indispensable, since its readings of insulation resistance afforded the only fully reliable indication that the motor was fit for use. The Megohmer check thus avoids all danger of a failure due to incomplete bake-out and, at the same time, guards against unnecessarily prolonged treatment.

Insulation resistance tests are made on all newly-installed electrical equipment before power is applied for the first time. It is thus possible to detect faults in both materials and workmanship and thereby to avoid all chance of disputes with equipment manufacturers.

The instrument is also used to good advantage when re-winding is being done in the electrical shop. Electricians can locate the trouble much more quickly and definitely with the Megohmer than with other instruments available for this purpose and thus make considerable savings in time and repair cost.

Insulation Testing by Other Methods

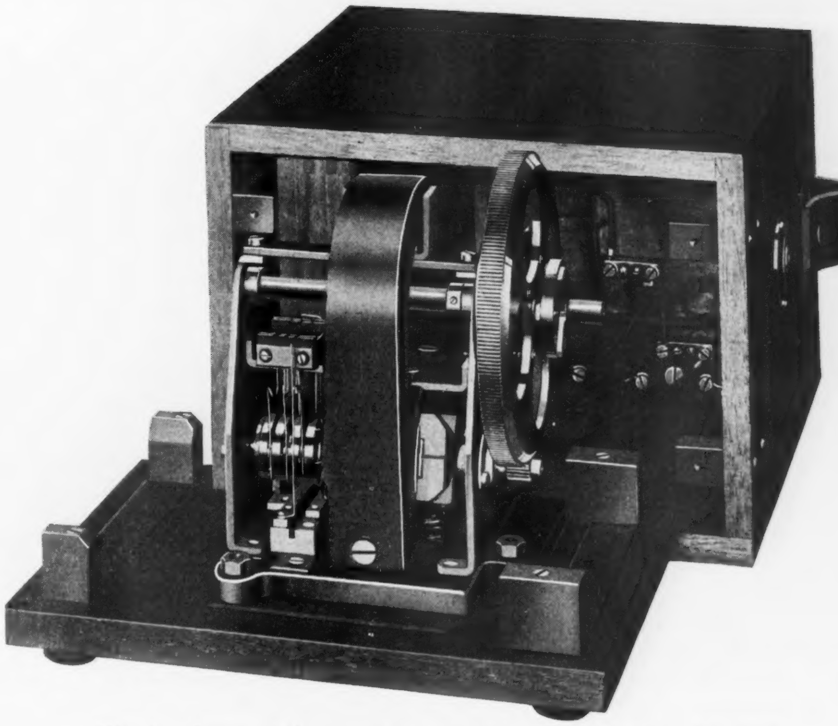
The bell-and-magneto method of insulation checking has been tried at this plant in the past but results are reported to have been wholly unreliable. Circuits having high impedance were often shown to be satisfactory, even when other tests indicated poor

Double purpose instrument combining a differential galvanometer having megohm and ohm scales, a hand-operated direct-current generator and a voltmeter for A.C. and D.C. measurements

*Survey made by A. C. Nielsen Co., engineers, in collaboration with and approved by Eugene Fluck, chief electrician, Lawrence Portland Cement Co., Northampton, Penn.

insulation resistance. Circuits of high capacitance, on the other hand, frequently gave test results indicating faulty insulation when, as a matter of fact, the insulation was in perfect condition.

The Megohmer test is considered far better than the magneto method, first, because it is strictly quantitative, and secondly, because it is applicable to any circuit, regardless of its characteristics, without chance of errors like those described above.



The hand-operated magneto generator removed from the case

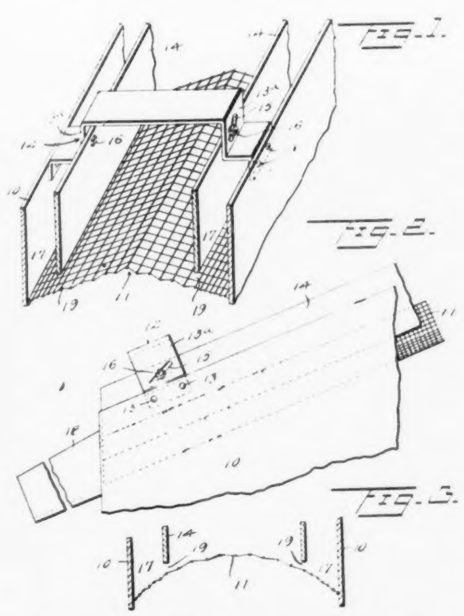
Device for Removing Flats from Gravel

W. J. GARRISON, manager, Silicon Products Co., Ridgway, Penn., has invented improvements in screening apparatus for the removal of flat particles from any material, and more particularly to improvements in the construction of apparatus for use in screening gravel.

An important object of his invention is to produce a structure which, with but slight modification of the screens of existing shaker tables, may be readily applied to the shaker tables and will serve to separate objectionable thin and flat particles from any material being screened.

A further and more specific object of his invention is to provide a screening structure in which these flats are separated from gravel in the ordinary process of screening and are passed longitudinally of the screen to a suitable discharge point.

A still further object of his invention is



Screening device for removing flats from gravel

the provision of a structure of this character in which the separating element or elements are adjustable to enable determination of the size of the flats which will be discharged from a given screen deck in a single or multi-deck screening apparatus.

These and other objects Mr. Garrison claims to attain by the construction shown in the accompanying drawing. Fig. 1 is a fragmentary perspective view showing screening and separating apparatus; Fig. 2 is a fragmentary side elevation; Fig. 3 is a fragmentary sectional view showing a slightly modified form of screen surface.

Referring to the drawing, the numeral 10 generally designates the side walls of a screen housing and 11 the woven screen unit which may be agitated in any suitable manner. These screens incline longitudinally and in accordance with his inventions are centrally crowned either by placing the opposite sides of the screen at an angle to one another, as shown in Fig. 1, or by accurately curving the screen, as indicated in Fig. 3. Extending over each screen are supports 12, the ends of which are secured to the separator walls, as indicated at 13. Each support 12 is provided with vertically extending portions 13a overlying the screen in spaced relation thereto and in spaced relation to the side walls. These vertically extending portions which are preferably provided by offsetting the support are abutted by longitudinal separator plates 14.

Each support 12 has formed in each of the vertically extending portions 13a thereof an angular slot 15 through which a bolt 16 carried by the associated plate extends.

It is claimed that by loosening these bolts and shifting the plates longitudinally the space of the lower edges of the plates from the screen may be regulated.

The screens outwardly of the plates 14 are preferably constructed to prevent the passage of flats which pass under the separating plates 14 but will pass material smaller than the flats thus separated. This is preferably accomplished by increasing the number of longitudinal wires or bars in the portions of the screen lying outwardly of the plates 14, thus decreasing the size of the mesh outwardly of the plates 14. This construction is more clearly illustrated in Figs. 1 and 3.

In the operation of the device, the material is discharged at the top end of the screen at the center, and due to the crown of the screen and the inclination the material tends to move transversely of the screen as it moves longitudinally. This causes the material to tend to bank up against the plates 14, and thin, flat particles in the material being treated are said to work out through the slots 19 under the lower edges of the plates 14 to the alleyways 17 provided between these plates 14 and the opposed wall 10 of the separator. The material passing to the alleyway passes longitudinally of the screen to a discharge outlet 18, which may, as illustrated, be disposed at the end of the separator.

It is claimed that the particular means of adjustment provided may be modified considerably without in any manner departing from the spirit of the invention.

A patent for the device is pending.

Consistency Measuring Device

L. A. PERRY, consulting engineer of the Pioneer Sand and Gravel Co., Seattle, Wash., has developed a device for indicating and recording the consistency and workability of the batch of concrete during mixing. The device was originated for use on the Pioneer company's ready-mixed concrete plants, but Mr. Perry has now completed arrangements with the Chain Belt Co. of Milwaukee, Wis., to manufacture the new machine in commercial quantities.—*Seattle* (Wash.) *Journal of Commerce.*

New Machinery and Equipment

Twelve-Ton, Gas-Electric Locomotive for Quarries and Sand Pits

MACK TRUCKS, INC., New York City, is now introducing a new gas-electric locomotive specially designed for quarries and contracting usage. The manufacturer has been manufacturing trucks and buses for 25 years, and the decision to enter the locomotive field is therefore natural, according to the announcement. The company has been building gas-propelled, passenger railway cars, and hence the locomotive is the result of years' experience and is not an untried and experimental product. The company has announced that it is prepared to supply gas-electric locomotives in a full range of sizes, for both industrial and railroad use, ranging from 10 tons to 80 tons and having 85 to 450 horsepower.

The 12-ton gas-electric unit is of particular interest in the rock products industry because it is especially suited for use on temporary track operations such as found in quarries and sand plants. This locomotive, which is designated as the "BR Special," is a single-engined, four-wheel model, with a narrow-truck-type cab and two "Bulldog" hoods identical with those used on the Mack trucks. Wheel gages from from 28 in. up are readily supplied. For ratings up to and including 12 tons, 30-in. wheels are used. On account of the larger motors required for heavier ratings, 33-in. wheels are used where these exceed 12 tons. The power plant is mounted on a rectangular frame of pressed chrome-nickel steel, resting on the main bed, with a cab in the center, the engine at one end and the generator at the other. Compactness and simplicity have been achieved by using a narrow steel cab with a single control station. Driving motors are located on the axles driving direct through spur gearing.

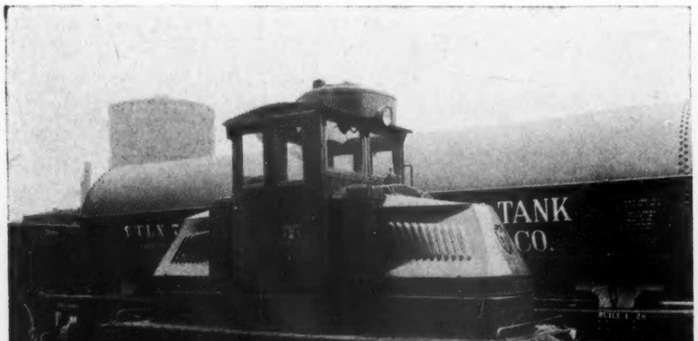
Power is supplied by a four-cylinder, heavy-duty Mack engine with cylinders 5x6, which develops a maximum brake horsepower of 85. This is virtually the same engine as is used in Mack Model AC "Bulldog" trucks. It is equipped with a 12-volt electric starting and lighting system and a magneto ignition. It is pump-cooled with a standard Mack dash type radiator through which air is forced by a beltless squirrel-cage blower on the flywheel. Drive from the engine is by a shaft beneath the cab floor connected by two rubber torque insulators with a 55 k.w. shuntwound generator carried under the other hood. A 12-ft. Westinghouse air compressor is driven from the rear of this generator, the fuel tank also being mounted under this hood. Large air reservoirs are mounted under the bed at each end.

Mack gas-electric locomotives require only a spare power plant to keep a whole fleet in continuous service, it is claimed. The company states that while power plant failure in the locomotive is a rarity, it is comforting to the operator to realize that in case of an emergency, the power plant may be lifted out bodily and a reserve unit installed. Such a change over requires only a few hours, it is stated. No other type permits the economy of investment in reserve locomotives that this power plant replacement feature of the Mack gas-electric makes practical, it is claimed. Another of the advantages claimed for the Mack gas-electric locomotive where its use is practical is that in addition to its low initial cost it is much more economical to operate than steam, this being due to the inherent economy of the internal combustion engine, combined with the fact that electric power is obtained not at meter rates but at the cost of production.

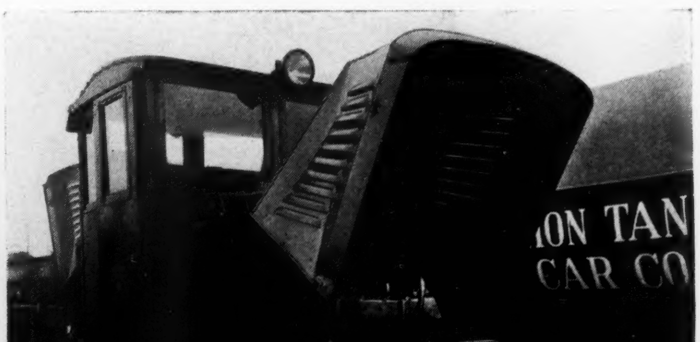
Ohio Equipment Manufacturer Forms Canadian Subsidiary Company

THE Jeffrey Manufacturing Co. of Columbus, Ohio, announces the incorporation of the Jeffrey Manufacturing Co., Ltd., at Montreal, Quebec. This new Canadian company has its head office and works in Montreal, a branch office in Toronto and a mining supply warehouse in Calgary, Alberta. The company's line of chains, portable loaders and elevating, conveying, pulverizing, crushing and mining machinery which for more than 50 years has been manufactured at Columbus, Ohio, will in the future be supplied by the new Canadian company.

The Jeffrey Manufacturing Co. of Columbus, Ohio, recently acquired the Galion Iron Works and Manufacturing Co. of Galion, Ohio, one of the largest and oldest manufacturers of road machinery. In addition to the Jeffrey line, it is the intention of the Jeffrey Manufacturing Co., Ltd., to supply the complete line of Galion machinery from its Canadian plant. The officers of the Jeffrey Manufacturing Co., Ltd., are R. W. Gillispie, president; R. H. Ross, treasurer and manager, and F. N. Diehl, secretary.



New 12-ton, gas-electric locomotive for industrial and quarry usage



Gas-electric locomotive with the hood raised to show power plant

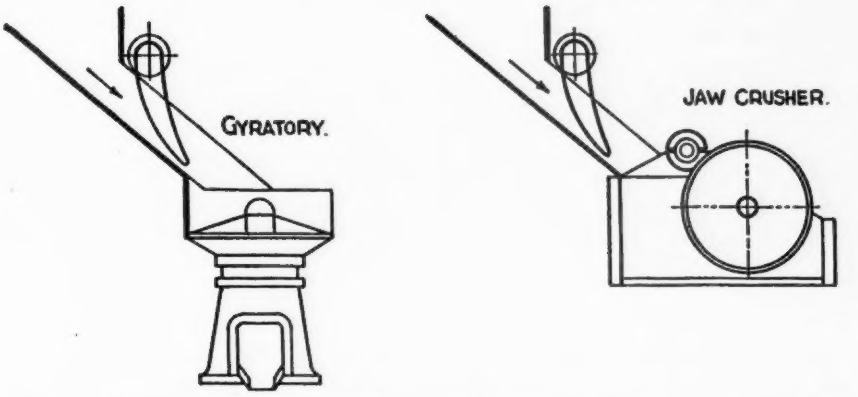


Diagram illustrating the use of the new chain feeder in gyratory and jaw crusher installations

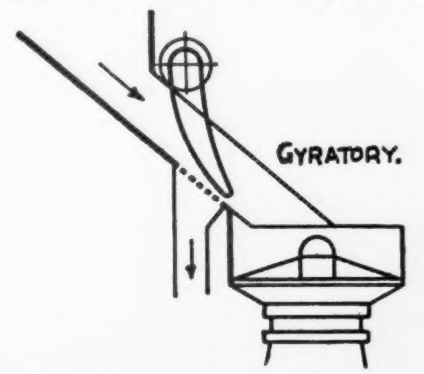
New Chain Feeder for Controlling Flow from Hoppers and Chutes

THE Ross Screen and Feeder Co., of New York City, has recently been introducing in this country a new type of feeder employing an endless chain principle which is applicable for feeding rock or ore to crushers, conveyors or similar equipment. This firm is controlled by Ross Patents, Ltd., of London, England, which first designed the feeder and patented it.

The Ross feeder consists of a curtain of endless steel chains, driven by an overhead tumbler and suspended in such a position that it will lie on the material and travel with it. It is able to control the flow of material in chutes and from hoppers because the chain curtain is sufficiently heavy to curb the most violent rush of material, it is claimed. As the curtain moves with the direction of the flow of the material, the latter is permitted to pass downward with a quiet, steady movement which is not greater than the speed of the curtain. Greater speeds are not possible because the grip of the chains is sufficient on the uneven surfaces to act as a friction clutch, permitting no sliding action between the rock and the curtain. It is claimed that the Ross feeder will handle any granular material of any size from quarry rock to coal slack.

This feeder is designed to eliminate some of the problems commonly found in feeding from hoppers and chutes. In feeding from gates it is not possible to get a good uniform flow, it is stated, because when the gate is lowered sufficiently to prevent too rapid flow it becomes easily blocked, and when the gate is completely opened to prevent blocking the result is that the material floods out. In feeding from a chute, similar troubles are met since a chute flat enough to produce a medium flow will cause the material to stop, and a steep chute designed to prevent stopping will immediately result in flooding. This Ross feeder allows a large enough opening or a steep enough chute to prevent stoppage, but controls the flow so that only a regulated amount can pass through.

It is claimed that the feeder automatically adjusts itself to fluctuations in the size of the material and that no labor or supervision is required. It is also stated that the chain apron can curb and stop the most violent rush of dumped material of any size without allowing any leakage, and can feed this material down quietly and steadily at any desired tonnage flow. The company claims that it is not a question of the feeder barely accomplishing the job, but instead it does it easily and with a lot to spare. The material may be any size and the hopper any height or the chute any size. Installations have been made where man-size stone has been dumped into a 35-ft. hopper, frequently empty, without leakage, and where as much as 30 tons has passed through a chute carrying the largest size that can be fed to a 72x 48-in. jaw crusher.



The chain feeder used in connection with a screen or grizzly

A combination of the Ross feeder placed above a screen or grizzly has been developed by the company. This is shown in one of the illustrations. It is claimed that there is no clogging of the screen holes when used with a feeder, as the following rocks remove any stone that may be temporarily stuck.

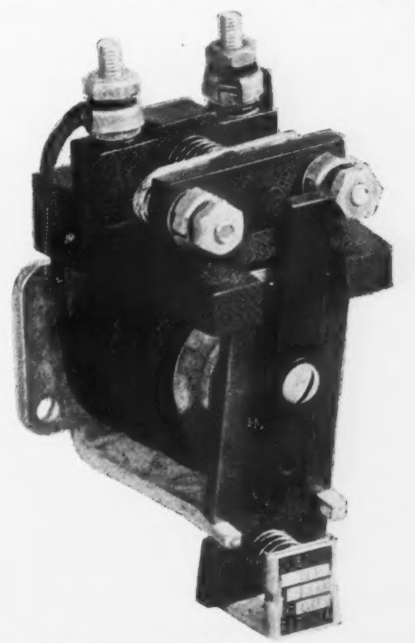
Welding Equipment Makers Occupy New Chicago Office

ON May 1, the Chicago district and central division offices of the various units of the Union Carbide and Carbon Corp. moved to the new 40 story Carbide and Carbon building at Michigan avenue and South Water street, Chicago. Units of the Union Carbide and Carbon Corp. which will make this new building their Chicago home are: The Linde Air Products Co., the Prest-O-Lite Co., Inc., Oxweld Acetylene Co., Oxweld Railroad Service Co., Union Carbide Sales Co., Carbide and Carbon Chemicals Corp., National Carbon Co., Inc., Haynes Stellite Co., J. B. Colt Co. and Acheson Graphite Co. These various subsidiaries of the corporation manufacture oxygen, acetylene, acetylene generators, cutting and welding equipment, carbon products, batteries, flashlights, chemicals, cutting tools and a number of other products.

The building itself is an architectural unit rising over 500 ft. into the air. The effect of great height inherent in its 40 stories is accentuated by the absence of all horizontal cornices and projections. The tower, beginning at the 23rd floor, continues to the 40th story and is here surmounted by a 50-ft. companile which forms the building's shining apex. It is the first great structure in Chicago to embody a free use of color in its exterior design.

New Relay Actuates Warning Signal in Alarm Circuits

THE General Electric Co., Schenectady, N. Y., has announced a new relay, known as CR-2810-1245, for use on various types of alarm circuits. This device is of the normally-closed type and functions to actuate a warning signal on the failure of power. The new relay is strongly built, of simple construction and operates very quietly, it is claimed. The contact construction is of the silver-to-silver type, and is double-break. It is made in standard ratings. Applications of the relay are expected to be many and various, ranging from simple failure of power, where no more serious consequences result, to more involved circumstances, where power failure would result in serious consequences. The warning signal controlled by the relay may be a bell or other device.



Relay to actuate warning signal

Empire State Sand and Gravel Association Meets at Utica

AN invitation to inspect the new plant of the Boonville Sand Corp. near Utica, N. Y., brought out a good gathering of members of the Empire State Sand and Gravel Producers Association at the meeting held in Utica on May 3. The visit was made in the morning before the luncheon and meeting, the members being taken out in cars to the plant located on Sterling creek, six miles east of Utica.

The new plant was a revelation to most of the visitors, as it is about the last word in sand plant design and construction. After a thorough inspection in which the operation was gone over from the dragline in the pit to the bins over the loading track, the guests agreed that it would be hard to find a better plant anywhere. The party then drove back to Utica, where the luncheon and meeting was held at the Hotel Utica.

President Henry F. Marsh, of the Consolidated Materials Corp., Rochester, presided at the discussion. The talk centered chiefly about two or three topics, such as the future development of the state association, the possibility of the association employing an engineer to protect the members from the competition of bad sand (principally wayside pit sand) and the attitude of the highway officials in general toward the producers.

Mr. Marsh asked the members what they thought should be the future course of the Empire state association. He said that it was possible that the association could join the National Sand and Gravel Association as a body, and added that H. V. Owens, of the Boonville Sand Corp., who is a director in the national association, would be able to supply more definite knowledge on what arrangement could be made by the time of the next meeting. Mr. Owens, who was present, stated that he would obtain more information at the coming directors meeting of the national association. As an alternative, Mr. Marsh said the Empire state association could continue to function as it was functioning, but he said he believed this was unsatisfactory.

Should the Association Employ Its Own Engineer

Harry Stelley of the Buffalo Gravel Corp. brought up for discussion a subject that the directors of the association had previously talked over. This was the advisability of engaging an engineer of recognized reputation under an agreement whereby any producer who had material rejected could call upon him to have it tested and if he found the material O. K. he would take the matter to the highway department to have it straightened out. Likewise if any producer found he was receiving unfair competition from poor sand the engineer could investigate and if the competitor's sand was really bad he could protest to the highway department. The idea behind the whole plan was to eliminate unfair competition from producers who are able to sell more cheaply because they do not meet the specifications, and was not to eliminate any producer or contractor whose material meets the specifications. If the engineer would find that material which some producer complained of was actually perfectly all right nothing would be done. The idea behind the thing was that the regular producers have felt for some time that the established plants were required to conform to the specifications rigidly, while frequently the wayside pit opened by the contractor could get by without really meeting specifications. Mr. Stelley suggested that if such a plan were adopted, it would be best to have the expense of the engineer borne by the individual plants for which he rendered service.

J. W. Robinson of Auburn asked if the roadside pit competition was really as great as indicated, saying that in his territory the state had largely put a stop to it. Both Mr. Marsh and John Carpenter said that they knew of recent cases where roadside sand had been used to the detriment of the road. Mr. Carpenter pointed out the highway department permitted material to be used if it passed the required tests and that the material could continue to be used as long as the quality was maintained. Unfortunately, however, the highway department has not stopped the work when a roadside pit ran out of good gravel and commenced on a poorer material. Too often the state's inspector allows the contractor to finish up a job with poor gravel on the excuse that there is only a little work left to do so it does not matter much. Actually the piecing out may be as much as a third of the whole job, Mr. Carpenter stated.

Nathan Oakes brought up the question of whether the proposed engineer would be able to advise producers on the design of plants, and Mr. Marsh stated that it was the intention to obtain a man who would be an expert on concrete materials but not necessarily on plant design, so that it would not be one of the duties of the new engineer to render advice on plant design.

Wayside Pit Material

M. E. Woodcock, Edwards, N. Y., declared that wayside material was the worst problem a contractor had to contend with, and that he felt that no contractor could afford to take a chance on questionable material. He pointed out, however, that if the association employed an engineer as suggested he must be a man whose opinion would amount to something with contractors and highway officials. H. V. Owens said that undoubtedly the man employed must have sufficient ability to make his word worth something at Albany, and he declared that it would be extremely hard to find such an engineer who could devote sufficient time to it.

Mr. Carpenter suggested that the state would possibly object to having an engineer attempt to change their decisions and this point was concurred in by a number of the members. Mr. Marsh stated that he thought the state would be glad to get aid in securing good gravel. Mr. Robinson suggested that it was not exactly questioning the state's opinion, since the fault usually lies entirely with one inspector when faulty material is used.

H. T. Smith of the Seaboard Sand and Gravel Corp., New York City, said that if a man of ability were employed some of the troublesome matters in regard to the state use of sand could be ironed out. He suggested as an example that Long Island sand

Members of the Empire State Sand and Gravel Producers' Association on a visit to the Sterling Creek plant of the Boonville Sand Corp. at the Utica meeting on May 3d

had all been eliminated from state work because it was found that some did not pass specifications, but he declared that much of it would pass specifications if someone could get the state to raise the ban. He suggested that the man necessary for the job would have to be like Stanton Walker of the National Sand and Gravel Association and would have to have a widespread reputation, or else he would be of little value. Mr. Smith added that Stanton Walker took care of just such a problem in New Jersey as confronts many New York producers, and settled it satisfactorily for the producers and state.

Mr. Owens suggested that a contractor can put up a wayside pit at some places that will produce sand meeting the specifications, and that when this is possible he would be foolish to overlook the chance. Mr. Owens added that, without the expense of employing an engineer, the association could do some good work towards getting good material by working for a specification requiring washing the sand. A valuable suggestion given by Mr. Owens was that one way to combat the wayside pit was through cooperation with the railroads. If the railroads can agree to put in a temporary low freight rate to a job point, the contractor will find little reason for opening his own pit. Mr. Owens added that the Lackawanna railroad was considering the establishment of such rates for highway material for a period of about six months.

Future of the Empire State Association

Mr. Owens said that he felt that the Empire state association could accomplish more if the operators joined the national association instead of employing their own engineer. In that way the producers could get the benefit of the unquestioned engineering ability and influence of the national association. Then the local association could be maintained more as a social group and to talk over small problems, while the difficult matters could be taken up by the national association.

John Carpenter suggested that it would be probably impossible to get a state specification on washing sand, but it might be possible to get the present specifications more rigidly enforced as to accurate grading and cleanliness. He added that his company was preparing to give a silt test to every carload of material that went out to make certain that it would not be rejected on that account on the job.

The question of getting an inspector to O. K. the gravel at the plant was brought up, and it was agreed that the state would not stand for such an expense. Mr. Smith of the Seaboard Sand and Gravel Corp. stated, however, that his company had found it necessary to refuse to ship to a job where the material is subject to inspection after it is on the job.

D. C. Hickey of the Rock Cut Stone Co. of Syracuse took entirely the opposite view of the proposed engineer from the previous speakers. He said the producers were unpopular enough with the contractors as it was and this would be like forcing something unpleasant down their throats. He agreed with Mr. Owens that the way to settle difficulties was through the national association. Commenting on Mr. Hickey's remarks, Mr. Stelley said that he really agreed but he had only brought up the matter to bring about a discussion which might bring out some valuable suggestions. He said that as far as his own company was concerned, membership in the national association was looked upon as insurance against just such difficulties.

The place of the next meeting was set for Albany during the latter part of June. Mr. Smith suggested that the association get Mr. Walker or Mr. Ahern of the national association to attend the meeting and discuss the problem with the members.

Registration

Henry W. Marsh, Consolidated Material Corp., Rochester; John G. Carpenter, Madison Sand and Gravel Corp., Hamilton; Leonard Claire, Alfred-Atlas Gravel and Sand Corp., Alfred; H. A. Stelley, Buffalo Gravel Corp., Buffalo; George Williams and E. J. Karley, Rome Cast Stone Co., Rome; W. W. Barclay, Pattersonville Sand and Gravel Co., Pattersonville; George Price and Wm. Lunn, New Milford, Penn.; M. E. Woodcock, Edwards; Harold T. Smith, Seaboard Sand and Gravel Corp., New York City; Scott Wuichet, Mohawk Limestone Products Corp., Mohawk; Nathan Oakes and Carlton Oakes, Oakes Corners; J. W. Robinson, Auburn; C. A. Adams, Rock Cut Stone Co., Solsville; H. V. Owens and W. D. Dodge, Boonville Sand Corp., Utica; D. C. Hickey, Rock Cut Stone Co., Syracuse; C. W. Maxwell, Albany Gravel Co., Albany.

Jack Wagner and Clyde Powers, Boonville Sand Corp., were hosts at the Sterling Creek plant.

Manufacturers' Representatives and Guests

N. S. Snyder and H. D. Alexander, Link-Belt Co.; John W. Lawyer, New Jersey Wire Cloth Co., Syracuse; A. E. Fielding, Niagara Concrete Mixer Co., Buffalo; J. Shumen Hower, equipment, Utica; John L. Klug, Craine, Inc., Norwich; V. J. Milkowski, Morris Machine Works, Baldwinsville; H. M. Fitch, ROCK PRODUCTS, Chicago, Ill.; L. D. Hudson, Nordberg Manufacturing Co., New York City; J. P. Fogarty, Barber-Greene Co., Utica.

Eastern Rock Products, Inc., Formed in Utica, N. Y., Merger

A NEW merger of sand, gravel and stone companies was made known on April 3 when the Eastern Rock Products, Inc., was incorporated at Utica, N. Y. The new corporation, which will engage in the production and distribution of all commercial grades of sand, washed and screened gravel and crushed stone, is a merger of Boonville Sand Corp., Peerless Quarries, Inc., and Broome County Sand and Gravel Corp., all of Utica.

The capital stock consists of 3000 shares of 7%, $100 par value preferred stock and 15,000 shares of no par value common stock.

The officers of the corporation are: Harold V. Owens, president and treasurer; Henry R. Beebe, vice-president; Albert S. Owens, vice-president and manager of sales; George F. Ferris, secretary.

The above officers, with T. Harvey Ferris, comprise the board of directors.

The plants, formerly operated by the three merging companies and which will be operated under the new management, are as follows:

Plant No. 1. Boonville. Capacity 2000 tons per day of all grades of screened sand.

Plant No. 2. Forestport. Capacity 800 tons per day of washed and graded sand.

Plant No. 3. Sterling Creek, six miles east of Utica. Capacity 2500 tons per day of washed sand, washed and screened gravel and crushed gravel.

Plant No. 4. Herkimer. Capacity 300 tons per day of washed sand and gravel.

Plant No. 5. Oriskany Falls. Capacity 1800 tons per day of crushed and washed limestone.

Plant No. 6. Solsville. Capacity 400 tons per day of washed and graded sand.

Plant No. 7. Chenango Bridge. Capacity 800 tons per day of washed sand and gravel.

The corporation is also joint owner with J. F. Paddelford of Sherburne of the Chenango Valley Sand and Gravel Co., Inc., which owns and operates two plants, at Sherburne and Whitney Point, with daily capacities of 1000 tons and 800 tons respectively of washed sand and gravel. J. F. Paddelford is president of Chenango Valley Sand and Gravel Co., Inc., and Harold V. Owens is secretray and treasurer. This corporation has its offices at 404 Court street, Utica, with those of Eastern Rock Products, Inc.—*Utica* (N. Y.) *Observer-Dispatch.*

Alfred-Atlas Gravel and Sand Corporation Makes Plant Improvements

DURING the past winter season the Alfred-Atlas Gravel and Sand Corp. at Alfred, N. Y., has been making a number of improvements and additions at its plant. The chief change in the installation of a new Beaumont drag scraper with 1½-yd. bucket to deliver the material from the pit to the plant hopper. The previous operation was by shovel and truck haulage, but because of the proximity of this pit to the plant and the height of the bank at this point it was decided that the new installation would be much more satisfactory.

Among the other changes made at the plant is the enlarging of the storage bins and the addition of a second Telsmith settling tank. Also the ¼-in. screens are being replaced by 3/16-in. screens. Ray Wingate, the secretary of the company, is the plant engineer, while Leonard Claire, the superintendent, had charge of the installation of the improvements.

Rules of Contest Announced Governing Safety Competition in Sand and Gravel Industry*

ROCK PRODUCTS has offered to present a prize of $250 in the form of a loving cup, or other suitable emblem, to that member of the National Sand and Gravel Association having the best no-accident record in any one year in a safety contest to be supervised by the U. S. Bureau of Mines. The offer has been accepted by the executive committee of the association, the committee recognizing that the sand and gravel industry almost stands alone among industries of the country in its failure heretofore to promote safety work and eliminate accidents in its operations.

It is the earnest wish of the executive committee that the membership will lend the full extent of their cooperation in the conduct of the contest. Without the assistance of every individual company, the efforts will be fruitless. The benefits to be derived from participating actively in the campaign are readily evident, for quite aside from the natural desire to save life and prevent injuries the expense to any industry on account of time lost through injuries caused by foolish risks of the employes or through the employer's neglect in not providing safeguards in his operations amounts to a staggering sum.

Another factor which must not be overlooked is that there is at the present time absolutely no information of any kind available concerning accident experiences in the sand and gravel industry, although it is one of great magnitude, whether measured by tonnage or value. The Bureau of Mines and the National Sand and Gravel Association should know how the sand and gravel industry compares with other branches of mining and quarrying in the matter of safety to its employes. In the absence of any kind of information or data, the industry is handicapped in several ways. An illustration in this regard is to be had in the case of a state insurance commission which fixed a rate for compensation insurance for employes in the sand and gravel industry, on the assumption that they were engaged in more hazardous occupation than railroad brakemen. It would seem manifest that this is not proper, but their contentions could not be refuted. Therefore, the contest initiated by ROCK PRODUCTS in the sand and gravel industry should be the means of developing a great deal of useful information. The producer who wins the award will have every right to feel proud of the fact that his plant out of all in the United States has the best record in protecting the lives of his employes.

The contest will be conducted under the supervision of the U. S. Bureau of Mines, with W. W. Adams, supervising statistician of the bureau, acting as the official immediately in charge of collection and compilation of the necessary information. At a conference of representatives of the National Sand and Gravel Association with Mr. Adams and other officials of the bureau, a set of rules to govern the contest were formulated, together with the form of reports to be used by members of the association in furnishing the information which will be required. A committee of the association will be appointed to work with the bureau when the time comes for making the award.

Rules of the Contest

Following is a copy of the rules which have been officially approved by the Bureau of Mines:

1. *Trophy:* ROCK PRODUCTS has offered a prize of $250 in the form of a loving cup, plaque or some other suitable emblem to be selected by the appropriate committee, to be awarded to that member of the National Sand and Gravel Association having the best no-accident record in any one year in a safety contest to be supervised by the U. S. Bureau of Mines.

2. *Eligibility:* Sand and gravel plants employing 10 or more men. To maintain eligibility, the plant must be active at least 150 days, having worked a minimum of 12,000 hours.

3. *Contest period:* January 1 to December 31, 1929.

4. *Scope of contest:* The contect covers accidents and man-hours worked by all employes at the plant who are employed by the same company, and includes work up to point of delivery of the material directly to consumer or to independent agency of transportation; in other words, to point of relinquishment of control of the material by the producer.

5. *Separate enrollment of each plant:* A separate enrollment application should be filed for each plant. A company may select one or more of its plants for entry in the contest.

6. *The winner:* The winner will be the plant having the lowest accident-severity rate; that is, the smallest loss of time from all fatal, permanent and lost-time injuries per 1000 man-hours worked, together with lost time equivalents from accidents referred to in Rule 7a.

7. *Reports required:*

A. Accident reports: Competiing companies agree to send to the United States Bureau of Mines a separate and full report of each lost-time accident. (A lost-time accident is defined as one that causes loss of time beyond the remainder of the day on which the accident occurred. This covers injuries that do not incapacitate an employe for work until some time in the future; e. g., as the result of infection.) All fractures or permanent injuries should be reported *even if no time is lost;* also all temporary injuries that prevent an employe from performing his *regular duties,* even though during convalescence the injured employe returns to lighter work. Fractures, in case where no time is actually lost, will be weighted in lost days according to the bureau's scale showing average duration of disability classified by nature of injury. Companies may use accident report form supplied by the Bureau of Mines, or they may send the bureau a copy of their reports to the state commission or their insurance carriers. Each accident report should show date of injury, date that disability begins, date of ability to resume work and number of *calendar* days lost. In counting the number of calendar days lost, the day of injury should not be counted. The plant's enrollment or entry number should be shown on each accident report.

B. Exposure reports: The number of man-hours of employment or exposure should be reported on forms supplied by the Bureau of Mines.

8. *When to send reports:* Accident reports should be mailed to the Bureau of Mines, Washington, D. C., when the injured employe returns to work or when disability ceases. They may, if desired, be mailed to the bureau at the close of each month. However, *all reports should be mailed before January 31, 1930,* so that the winners of the contest may be announced early in the year. Reports of man-hours worked may be mailed whenever convenient to the reporting company.

TABLE 1

Nature of injury	Degrees of disability in per cent of permanent total disability	Days lost
Death	100	6000
Permanent total disability	100	6000
Arm above elbow, dismemberment	75	4500
Arm at or below elbow, dismemberment	60	3600
Hand, dismemberment	50	3000
Thumb, any permanent disability of	10	600
Any one finger, any permanent disability of	5	300
Two fingers, any permanent disability of	12½	750
Three fingers, any permanent disability of	20	1200
Four fingers, any permanent disability of	30	1800
Thumb and one finger, any permanent disability of	20	1200
Thumb and two fingers, any permannet disability of	25	1500
Thumb and three fingers, any permanent disability of	33⅓	2000
Thumb and four fingers, any permanent disability of	40	2400
Leg above knee, dismemberment	75	4500
Leg at or below knee, dismemberment	50	3000
Foot, dismemberment	40	2400
Great toe, or any two or more toes, any permanent disability of	5	300
One toe, other than great toe, any permanent disability of	0	......
One eye, loss of sight	30	1800
Both eyes, loss of sight	100	6000
One ear, loss of hearing	10	600
Both ears, loss of hearing	50	3000

For calculating days lost from *temporary* injuries see Rules 7a and 9.

*Reprinted from the April issue of the *National Sand and Gravel Bulletin.*

9. *Method of rating:* Plants will be rated according to their accident-severity rates; that is, according to number of calendar days of personal disability form injuries per 1000 man-hours worked by all employes except office workers located at the plant. Deaths and permanent disabilities are weighted according to the scale named in the accompanying Table 1. Temporary disabilities are weighted according to actual calendar days of disability, including Sundays and holidays, and days on which the plant is idle. The severity rate is determined by dividing the total number of days lost by the total number of man-hours worked.

10. *Miscellaneous:* The above rules shall govern the contest during 1929. The rules for subsequent years may be revised as experience shows to be advisable.

11. *Access to records:* The executive secretary of the National Sand and Gravel Association may, when necessary, have access to all contest records.

12. *Scale:* Injuries that cause death or permanent injuries will be weighted in lost days according to figures in last column of Table 1.

The forms for use in the safety contest will be placed in the hands of all members of the association within a short time. It is hoped that every company will cooperate in making the contest a real success.

1930 Road Show to Be at Atlantic City

THE 1930 CONVENTION and road show of the American Road Builders' Association will go to Atlantic City. The nation's largest assemblage of men, machinery and materials will gather for the 27th annual event January 11-18.

This announcement was made at Washington, D. C., May 3, at the annual business session of the association, by Frederic A. Reimer, consulting engineer of East Orange, N. J., the incoming president.

The president's dinner and installation of new officers followed a two-day meeting of all association committees, divisions and the directorate. Mr. Reimer succeeded R. Keith Compton, director of public works, Richmond, Va., who became a director.

James H. MacDonald, New Haven, Conn., continues his years of service as treasurer, and Charles M. Upham, Washington, D. C., continues as secretary-director.

Other new directors are J. S. Helm, Standard Oil Co., New York, and Arthur W. Dean, chairman, State Highway Commission, Boston, Mass.

Charles E. Grubb, county engineer, Wilmington, Del., was installed as head of the county highway officials' division, succeeding T. J. Wasser, Jersey City, N. J.

Atlantic City was chosen for the 1930 meeting after a long and vigorous fight on the part of Cleveland to have the road builders return there. Cleveland has entertained the past two gatherings, the most successful in the organization's history. St. Louis also was a spirited bidder for the meeting.

"The board of directors is of the opinion that it is advisable to hold the convention and exposition in different parts of the country from year to year," Mr. Upham declared. "We had that policy in mind when we left Chicago two years ago after meeting for five years there, and brought the 1926 show to Cleveland.

"That year's convention was so successful as to cause our return there last year, but a further change of location this year is deemed suited to the best interests of our entire association."

Mr. Upham predicted a greater attendance, not only of engineers and highway officials from the United States, but of Pan-American and European representatives at Atlantic City than has ever before gathered for a road show and convention. All Pan-American steamship lines are granting a 25% reduction in fares for the convention, he said.

Twenty Pan-American countries and ten nations of the Old World were represented in the 30,000 attendance last January at the Cleveland convention and show.

Ohio Dimension Stone Quarries in Merger

MERGER of the Cleveland Stone Co., operators of the Berea quarries, and the Ohio Quarries Co. was announced recently.

The name of the new company formed as a result of the merger will probably be the Cleveland Quarries Co., and gives Cuyahoga County the second largest dimension stone company in the country.

Besides operating at Berea, Ohio, the Cleveland Stone Co. has quarries in Amherst, Wakeman and Marietta, Ohio, and at Grindstone City, Mich. The quarries of the Ohio Quarries Co. are at Birmingham and Amherst, Ohio.

W. A. C. Smith and F. D. Kellogg, president and vice president-treasurer, respectively and principal stockholders of the Ohio Quarries Co. will be substantial stockholders in the new company and will be active in its direction it was announced.

It was learned on good authority that the principal executive officers of both companies will continue with the new organization, which is to be headed by the following officers: W. A. C. Smith, chairman of the board, H. W. Caldwell, president of the Cleveland Stone Co., president; F. D. Kellogg, executive vice-president and treasurer of the Cleveland Stone Co., vice president and treasurer.

The Cleveland Stone Co. is one of Cleveland's oldest business organizations, having been formed in 1886. The stone quarries in Berea represent the sandstone and grindstone capital of the United States. A geological survey disclosed that 93% of all the grind-stones in the United States bore the mark of Berea. Sandstone and flagging are also quarried at the local quarries.

In addition to Messrs. Caldwell and Miller, the principal officers of the Cleveland Stone Co. are T. A. Giberson, vice-president; L. M. Joe, vice-president, G. J. Senn, vice-president and E. A. Burr, secretary.

The new company probably will acquire the Ohio Cut Stone Co., according to reports. This concern has the largest capacity of any cut stone company between New York and Chicago, Ill.—*Berea* (Ohio) *News.*

Increased Activity in Northwest

INCREASED CONSTRUCTION activity in the northwest was forecast this month when North Dakota broke all previous records by receiving in three days three solid train loads of portland cement from the Duluth plant of the Universal Portland Cement Co. These are said to be the first trains of cement ever shipped into North Dakota.

A celebration in recognition of North Dakota's new record, held on April 2 at Fargo, was attended by many contractors and dealers and by representatives of the Greater North Dakota Association, North Dakota newspapers, railroads and the cement company. A similar celebration occurred the following day at Grand Forks. North Dakota business leaders expressed gratification over the record shipments and stated that they pointed to increased construction activity this year.

The trains totaled about 140 cars or about 80,000 sacks of cement. They were routed from Duluth over three roads, the Northern Pacific, the Great Northern and the Soo line. The shipments went to about 125 dealers in as many different towns throughout the state.

The prospective building indicated by these record shipments confirms predictions made in December by over 700 North Dakota building material dealers. In a survey of dealers conducted at that time by the Universal company, over 78% of the North Dakota dealers predicted that 1929 would equal or surpass last year's construction volume.

New Tennessee Quarry Development

PLANS for a $100,000 company for the development of limestone quarries at Newsom Station, Tenn., were revealed recently with the filing of an application for a charter incorporating the Big Harpeth Quarries, Inc. The company, which is headed by Ralph E. McClean, plans to start operations soon. Several large veins of limestone rock fit the territory for the project.

The company will operate on 100 shares of common stock with a value of $100 each per share. Incorporators of the company are Ralph E. McClean, Morris E. McClean, George G. Keith, Herbert Fox and J. G. Stephenson.—*Nashville* (Tenn.) *Banner.*

General Crushed Stone Co. Buys Rock-Cut Stone Co.

THE GENERAL CRUSHED STONE CO., Easton, Penn., John Rice, president, announces that on April 28 the purchase of the Rock-Cut Stone Co., Syracuse, N. Y., was completed. The two companies will be merged and operated under the name of the General Crushed Stone Co.

The Rock-Cut Stone Co. had three quarries and crushed-stone plants at Rock Cut (Jamesville), near Syracuse, Auburn and Watertown, N. Y., with a total capacity of from 750,000 to 1,000,000 tons per year. W. L. Sporborg was president and A. G. Seitz, general manager. The company also owned and operated three sand and gravel plants at Ballina, Solsville and Watertown, N. Y., so that the General Crushed Stone Co. now becomes a considerable producer of sand and gravel as well as crushed stone. It is rumored that the Solsville sand and gravel plant was recently sold to the new Eastern Rock Products, Inc., Utica.

Blue Diamond Co., Los Angeles, Enters Cement Industry

THE BLUE DIAMOND CO., Los Angeles, Calif., producer of sand, gravel and crushed stone, manufacturer of lime and gypsum products, dealer in building materials of all kinds, announces the opening of a plant to grind imported Belgian portland cement clinker to make "Blue Diamond" brand portland cement.

Southwestern Division, National Crushed Stone Association, Meets at Austin, Tex.

THE SOUTHWESTERN DIVISION, National Crushed Stone Association, at its meeting in Austin, Tex., on April 26, had as its guest A. T. Goldbeck, director of the bureau of engineering of the National Crushed Stone Association.

The meeting of the Southwestern Division at Austin was called to order by Chairman Eikel, who expressed the sentiment of all present in welcoming Mr. Goldbeck. The regular order of business was dispensed with in order to hear from Mr. Goldbeck on the work of the bureau of engineering and to discuss suggested revisions of the specifications of the Texas highway department. The entire meeting was devoted to this subject, and many helpful and constructive suggestions were given by Mr. Goldbeck.

In company with Secretary-Manager Hank of the Southwestern Division, Mr. Goldbeck visited the Texas highway department offices at Austin, where the various engineers were met and matters pertaining to the crushed-stone industry were discussed. A visit to and inspection of the highway department's testing laboratory was also made.

The following members of the Southwestern Division were represented at the Austin meeting on April 26; Texas Trap Rock Corp.; Landa Rock Products Co.; New Braunfels Limestone Co.; Dittlinger Lime Co.; Southwest Stone Co.; Stringtown Crushed Rock Co., and R. J. Hank, secretary-manager, Southwestern Division.

On the morning of April 27, Mr. Goldbeck again visited the highway department and discussed in detail the matter of specifications for concrete pavement.

H. H. Blaise

H. H. BLAISE, former chief chemist and general superintendent of the Great Western Portland Cement Co., Kansas City, Mo., died at Egypt, Penn., April 23. At the time of his death he was with the operating department of the Giant Portland Cement Co.

Mr. Blaise began his career in the portland cement industry as a chemist with the Lehigh Portland Cement Co. at the Mason

H. H. Blaise

City, Iowa, plant. Subsequently he went to the Northwestern States Portland Cement Co., Mason City, as assistant chemist. During the world war he was in the service as a chemist with the United States Army detailed to the manufacture of poison gases. He returned to the cement industry as chief chemist of the Gulf States Portland Cement Co. In 1921 he went to the Great Western Portland Cement Co., Kansas City, where he served progressively as chief chemist and as general superintendent in charge of construction and operation.

After leaving the Great Western company he returned to Mason City, Iowa, where he specialized in consulting work in connection with cement manufacture. As such he was instrumental in starting operation at the new plant of the Northwestern Portland Cement Co., Grotto, Wash., in 1928. He had been at the Giant company's plant in Egypt, Penn., about a year.

Mr. Blaise was the author of several articles in ROCK PRODUCTS on problems of the portland cement industry, including one on the comparative merits of the wet and dry processes of manufacture, which is soon to be published. He is survived by a widow and a brother, P. C. Blaise, now with the Missouri Portland Cement Co. at Independence, Mo., who recently returned to this country from an extensive experience in the portland cement industry of South America.

Callanan Road Improvement Co. Buys Albany Crushed Stone Co.

THE CALLANAN ROAD IMPROVEMENT CO., South Bethlehem, N. Y., near Albany, owners and operators of one of the oldest commercial crushed-stone quarries in the state, has purchased the quarry and plant of the Albany Crushed Stone Co., Feura Bush, N. Y., a short distance from South Bethlehem.

The Albany Crushed Stone Co. has had an interesting and enlightening history, as consistent readers of ROCK PRODUCTS probably know. It was promoted and built in 1924 and 1925 by men wholly unfamiliar with the crushed-stone industry. Some serious errors were made in the design and in opening the quarry. In ROCK PRODUCTS, October 31, 1925, a description of the operation was published together with some frank criticism of its shortcomings. The plant was designed and built to produce 4000 tons a day, before any money to speak of had been spent for quarry development.

The result was that instead of an investment of $200,000 which the promoters originally planned on, probably nearer $500,000 was spent altogether including plant changes and on quarry development work. At the time ROCK PRODUCTS used this plant as an example of the unseen, unlooked-for costs of engaging the crushed stone business on a large scale with slight knowledge of it.

The End of a Perfect Story

Since its start the operation has had a hard struggle for existence. It was operated for a year under lease to the Rock-Cut Stone Co., Syracuse. Its final fate—sold to its old and nearby competitor—is a fitting climax to the story of an attempt by a very well financed, but uninitiated, group of outsiders to engage in the commercial crushed-stone business in competition with seasoned operators.

The officers of the Callanan Road Improvement Co. are H. E. Battin, president; B. R. Babcock, vice-president; Ronald Kinnear, secretary; H. C. Callanan, treasurer; J. R. Callanan, general manager; K. M. Callanan, assistant general manager.

News of All the Industry

Incorporations

H. Hinkes & Son, Inc., Newark, N.J.; $100,000. Gravel and ashes.

Dickason Sand and Gravel Co., Wilmington, Del.; $50,000.

John Wright and Co., Inc., Stoneharbor, N. J.; $20,000. Sand and gravel.

Progress Building Materials Co., Haddonfield, N. J.; $125,000. Carlton B. Webb.

South Jersey Concrete Co., Riverside, N. J.; $50,000. George M. Bacon.

Clem Gravel Co., Dallas, Tex., decreased capital stock from $300,000 to $50,000.

Dundee Limestone Co., Wilmington, Del.; $200,000.

Shore Sand and Gravel Co., Asbury Park, N. J.; $100,000. Walter Taylor.

Long Branch Cement Block Co., Inc., Long Branch, N. J.; $2000. L. S. Throckmorton.

Sea Isle Junction Sand Co., Bridgeton, N. J.; 2500 shares common. Frank S. McKee.

Wright Builders Supply, Ltd., Hull, Que., Canada; 1000 shares, no par.

Pioneer Sand and Gravel Co., Seattle, Wash., increased capital stock from $2,000,000 to $3,000,000.

Black Stainless Gourt Co., Paterson, N. J.; $125,000. Morris F. Levin. Cement products.

Concrete Products Development Corp., Elizabeth, N. J.; 2500 shares, no par.

Atlas Sand and Gravel Co., Houston, Tex.; $30,000. J. E. Boyd, R. A. Griffin and W. P. Callaway.

Duck Creek Stone Co., Howard, Wis.; 250 shares common, $100 each. H. Beemster, W. Sheedy and C. G. Chadek.

Prospect Sand and Stone Co., Muskego, Wis.; 1000 shares, $100 each. E. H. Spoor, W. Moran and E. Pagliarul.

Southern Concrete Products Co., Fort Worth, Tex.; $1000. George A. Nelson, B. O. Head and Atwood McDonald.

Dayton Limestone Quarry Co., Dayton, Ohio; 250 shares, no par. Charles R. Short, Virgil Schaeffer and Attilio Angelo.

Kesler Marl and Lime Co., Hillsboro, Ohio; $40,000. L. C. Kesler, J. S. Kesler and John West.

Sagamore Duntile Manufacturing Co., Bourne, Mass.; $25,000; 250 shares, $100 each. Clifton H. Handy, president, and Margaret L. Carroll, treasurer. Cement products.

Wagner Building Material Co., Wichita, Kan.; $25,000. Harold A. Wagner, Ethel Wagner, Roy Sourbeer, V. W. Henricks, all of Wichita, and M. J. Healy, Topeka.

Reliance Cement Corp., Wilmington, Del.; $100,000. Harry Field George Cowell and Samuel Weberman, New York City. Sand, gravel, rock, stone, etc.

France Stone Co., Toledo, Ohio, filed papers permitting it to do business in Indiana. Capital in Indiana, $7090. C. W. McKee, of Huntington, agent.

Portland Trap Rock Co., Inc., Portland, Me.; $10,000, all common, par $100; nothing paid in. Fred C. Phelan, South Portland, president; Giuseppe Casale, Portland, treasurer, and Lawrence B. Anderson, Portland, director.

Builders Products Corp., Winchester, Conn.; 5000 shares preferred, $10, and 10,000 shares common, $5; paid in, $1000. Hadleigh F. Howd, Helen F. Quinn and Charles Hollister. Building materials.

Universal Silicate Stucco and Lime Products Corp., San Francisco, Calif.; 50,000 shares preferred stock, par $100, and 500,000 shares common, no par. John J. Abramson, president; Frank H. Bode, Ralph Hansen and Herman A. Bachrack, directors. It is an organization formed for the purpose of acquiring all stock in the Abramson-Bode Corp. of Delaware and the Universal Silicate Stucco Co. of California through an exchange of stock.

Sand and Gravel

Granite Sand and Gravel Co., Indianapolis, Ind., has filed papers evidencing final dissolution. The property of this company has been taken over by the American Aggregates Corp. of Greenville, Ohio.

Keystone Sand and Supply Co., Pittsburgh, Penn., is planning to construct a dock for unloading sand and gravel in the Ohio river at Steubenville, Ohio, and has already Federal permission to go ahead with the work.

Osage Gravel Co., Jefferson City, Mo., has leased the Bagnell Hotel at Bagnell, Mo., where the company's plant is located, and will use it to supply board and rooms for the men who work in the plant. The company has commenced its spring operation with a double force of two ten-hour shifts. About 25 men will be employed regularly.

Iowa Sand and Gravel Corp., Oskaloosa, Iowa, began this year's operations at its plant at Eddyville on April 24. The upstream plant was rebuilt this spring, new equipment installed, and the capacity of the plant increased. Early spring floods proved costly to the plant in many ways and necessitated expensive repairs. The industrial railroad which connects the upstream plant with the main plant was washed out and had to be rebuilt.

Quarries

Colorado Fuel and Iron Co., Pueblo, Colo., plans to ship 2100 tons of lime rock daily from its new quarry at Monarch, Colo., when that plant is placed in operation. The quarry at Calcite, which has supplied flux stone for this company, will be closed about June 1, it is reported.

North Jersey Quarry Co., of which Irving H. Wortman is president, bought 178 acres known as the "mountain property" in Short Hills, N. J., from the Baltusrol Golf Club. The sale was for all cash. The parcel, held at $178,000, was part of 355 acres which the Louis Keller estate sold to the club about eight months ago, and represents that part of the property which the club did not intend to use.

Dubuque Stone Products Co., Dubuque, Iowa, suffered a rock slide at its plant which completely blocked the highway which passes through the quarry property, but did no other damage. At this operation the quarry is in the bluffs above the Mississippi river and the plant is below at the foot of the bluff. Between the plant and the quarry is the much-traveled highway which leads to the Eagle Point bridge over the Mississippi. A portion of the outer edge of the quarry floor crashed down on the highway, but because the Dubuque company engineers had discovered that the crash was impending before it happened, there was sufficient warning and no one was injured. There was also time for the removal of telephone and power lines from the danger zone. The crew from the quarry was set to work immediately after the crash to clear the highway and this was accomplished in record time. The cause given for the slide was undercutting of the rock during the building of the highway, aided by freezing and thawing action during the past winter.

Cement

Great Lakes Portland Cement Co., Buffalo, N. Y., is installing "Norblo" dust-collecting equipment in its new Cleveland, Ohio, pack-house.

Pennsylvania-Dixie Cement Corp., Nazareth, Penn., announces the removal of its New York offices to 521 Fifth Ave., at 43rd St., New York.

Castalia Portland Cement Co., Castalia, Ohio, is installing "Norblo" dust-collecting equipment on its finish-grinding mills.

Lone Star Cement Co., Alabama, Inc., Birmingham, Ala., is reported in the *Demopolis* (Ala.) *Times* to be installing two new finishing mills at its Spocari plant.

Alpha Portland Cement Co., Easton, Penn., resumed operations in all departments of its plant at Manheim, W. Va., on May 1, according to a report in the *Terra Alta* (W. Va.) *Republican*.

Vulcanite Portland Cement Co., Philadelphia, Penn., kept open house for dealers recently when its new offices in the palatial new New York Central Bldg., 45th St. and Park Ave., New York City, were thrown open for inspection.

Universal Portland Cement Co., Buffington, Ind., shipped finished cement for the first time from the plant by way of the Buffington harbor on April 26. Although the harbor has been receiving shipments of stone regularly for the past two years, this is the first cargo of the finished product to be sent out in this way. Regular shipments from the Buffington plant to other lake ports will follow, plant officials said. The initial cargo was sent to Milwaukee.

Cement Products

St. Marys Block Co., St. Marys, Penn., has established a plant in that city for the manufacture of cement products. Alex Krieg of St. Marys and J. H. Kinley of Ridgway, Penn., are the owners.

Atlantic Building Supply Co., Atlantic, Iowa, has installed new concrete block equipment in its plant making it possible to double the capacity with less labor. The plant now turns out 1100 blocks daily.

Jamestown Cement Products Co., Jamestown, N. Y., has erected a new plant on the north bank of the Chadakoin river for the production and distribution of ready-mixed concrete. M. H. Weber is the owner of the company and Robt. E. Bergman is the superintendent.

Lime

Wisconsin Lime and Cement Co., Chicago, Ill., is installing "Norblo" dust-collecting equipment in its pack-house.

The Finishing Lime Association of Ohio announces that A. P. Bick has been appointed district engineer with offices at 1258 Builders Bldg., Chicago, to represent the association in the district embracing Chicago, Minneapolis, St. Paul, northwestern Indiana and Wisconsin.

Miscellaneous Rock Products

Moorwood Products of Calgary, Alberta, has leased a plant site at Medicine Hat for a term of five years and is preparing for the installation of machinery and equipment. The company owns and operates its own talc, Fuller's earth and gypsum properties, and manufactures calcimine washing compounds, plaster of Paris and similar lines.

Personals

Col. John Stephen Sewell, president of the Alabama Marble Co. of Birmingham, is now serving on a commission to the Santo Dominican republic, where he went at the invitation of Charles G. Dawes. The Birmingham man has direct charge of the municipal budget system.

Raymond M. Sievers has been appointed district sales manager of Harbison-Walker Refractories Co., Pittsburgh, Penn. Mr. Sievers has been a member of the American Refractories Institute since its formation. From 1904 to 1928 he was connected with the Evens and Howard Firebrick Co., St. Louis, in various capacities, in 1925 having been elected vice-president and a director of that company. As district sales manager of Harbison-Walker Refractories Co., Mr. Sievers' territory extends from the Mississippi river to the Rocky Mountain states, and he will make his headquarters in St. Louis.

Obituaries

Edward F. Carry of Chicago, a director of the Atlas Portland Cement Co., died on April 24 at the age of 62. He was the president of the Pullman Car Co.

Benjamin C. Perry, Rockland, Maine, formerly connected with the Edward Bryant Co. of Boston, Mass., died on April 30 after a brief illness. Mr. Bryant had been associated with the lime manufacturing industry around Rockland for many years until his retirement in 1927. He was 69 years old.

Theodore L. Fehlig, president of the Fehlig Construction Co. of St. Louis, Mo., died on Monday,

May 6, at the age of 58 years. Mr. Fehlig had been identified with the quarry industry of St. Louis for many years and was vice-president of the St. Louis Quarrymen's Association at the time of his death. His death is a severe loss to the local association and to the industry around St. Louis, as his long service and dependability had earned the respect and friendship of all those with whom he came in contact.

Manufacturers

Hardinge Co., York, Penn., has moved its New York office from 120 Broadway to the Chanin Bldg., 122 East 42nd St.

Southern Iron and Equipment Co., Atlanta, Ga., who for the past twenty years have had their offices in the Grant Bldg., have moved their office to the company's works at Hemphill Ave. and Southern Railway, Atlanta.

Sullivan Machinery Co., Chicago, Ill., has moved its general offices and all departments from the Peoples Gas Bldg., 122 S. Michigan Ave., to the seventh and eighth floors of the Wrigley Bldg., 400 N. Michigan Ave., Chicago.

Trackson Co., Milwaukee, Wis., announces the appointment of the Cuyahoga Equipment Co., 5713 Euclid Ave., Cleveland, Ohio, as distributors of Trackson tractor equipment for the McCormick-Deering tractors in the Cleveland territory.

Boston Woven Hose and Rubber Co., Boston, Mass., announces that H. S. Merrill will represent it at Denver, Colo. C. W. Stanton, formerly at Denver, will be located at Cincinnati, Ohio, and L. P. McGoff will return to the New England states.

Pangborn Corp., Hagerstown, Md., announces it has taken over the Universal Shot and Sand-Blast Manufacturing Co., Hoboken, N. J. It will manufacture and furnish Universal equipment, parts and supplies. Robert E. Donnelly and Frank C. Weber are now associated with the Pangborn Corp.

Link-Belt Co., Chicago, Ill., has appointed the following three West Coast companies as representatives: A. H. Cox & Co., Seattle, Washington agent; National Machinery Co., Vancouver, British Columbia agent; and J. L. Latture Equipment Co., Portland, as Link-Belt crane and shovel agent for the state of Oregon and eastern Washington.

The Magnetic Mfg. Co. announce the issuance of a new bulletin, **No. 80**, devoted to Magnetic separation equipment for the concentration of ores and minerals. This new bulletin is just off the press and contains the theoretical and practical experience gained during the past 30 years of study of this field.

Timken Roller Bearing Co., Canton, Ohio, announce that H. H. Wood, formerly chief engineer of the Laclede Steel Co. of St. Louis, has joined their industrial department and will specialize in the application of Timken bearings to steel mill equipment. Mr. Wood's headquarters for the present will be in Canton.

Manganese Steel Forge Co., Philadelphia, Penn., announce the opening of their Pittsburgh sales office at 1714 Clark Bldg. The new sales office is in charge of J. H. McKinley. A Cleveland sales office has also been established at 623 Union Trust Bldg. in charge of P. M. Hobbs, who has been connected with the sales department of the company's main office and Chicago office.

Caterpillar Tractor Co., San Leandro, Calif., advise that their new "Caterpillar" Fifteen, which completes their line of small tractors, is ready for delivery. From the engineering standpoint, the Fifteen is a duplicate of the Ten, which has just gone into production at the new Peoria factory. It is just a little bigger than the Ten, and is a replica of it except in size and power.

Kirk & Blum Mfg. Co., Cincinnati, Ohio, announce the appointment of Brewster-Nicolas Co., 2169 West 25th St., Cleveland, Ohio, as their sales agents and representatives in the Cleveland territory. The company also announces that their Detroit district office in the General Motors Bldg. has been removed and a branch factory, with sales and engineering office, opened at 4718 Burlingame, Detroit, Mich.

Canda Gayley Steel Corp., Carteret, N. J., has taken over the business and good will of the Chrome Steel Works of that city. The new company is organized by Messrs. Abeel Canda and H. Clifford Gayley, who have been the active managers of the Chrome Steel Works for several years. C. E. Meissner, who has been development engineer for the Chrome Steel Works, will be sales manager for the new company.

S K F Industries, Inc., New York City, announce that the Buffalo, Detroit and San Francisco district offices of the company are now located in new headquarters as follows: The Buffalo office has moved from 517 Manufacturers and Traders Bldg. to Main and Genesee Sts.; Detroit office from 6520 Cass Ave. to 2820 East Grand Blvd.; San Francisco office from 115 New Montgomery St. to 221 Eleventh St.

Joseph Dixon Crucible Co., Jersey City, N. J., at the recent meeting of its board of directors elected Henry W. Armstrong treasurer, to succeed the late William Koester. Mr. Armstrong has been with the company in various capacities since 1903, when he entered its employ as an office boy. In 1920 he was appointed to the position of credit manager, and since 1926 has been assistant treasurer of the company.

Union Carbide Co., and associated companies, including Linde Air Products Co., Oxweld Acetylene Co., Prest-O-Lite Co., Union Carbide Sales Co., Oxweld Railroad Service Co., Electro Metallurgical Sales Corp., Haynes Stellite Co., and J. B. Colt Co., have moved their Technical Publicity Department from the Carbide and Carbon Bldg. to the Bartholomew Bldg., 205 E. 42nd St., New York City.

Manitowoc Engineering Works, Manitowoc, Wis., has appointed the Condon Bearing and Supply Co., Pittsburgh, Penn., as their representatives in the western Pennsylvania and West Virginia territory. The company also announces that Contractors Equipment Co., Detroit, Mich., has taken on the sale and servicing of Moore Speedcranes, shovels, draglines and trench-hoes, and also the Buffalo-Manitowoc clamshell bucket, in the state of Michigan.

Blaw-Knox Co., Pittsburgh, Penn., announce that A. W. French & Co., of Chicago, has been merged with their company. The personnel and policies of A. W. French & Co., manufacturers of the Ord concrete and asphalt road finishing machine, the Nu-Method finish grader, the new Bell wagon grader, etc., will continue as heretofore, and its plant and sales organization will function as a separate division of Blaw-Knox Co.

Robt. E. Rullman

Patterson Foundry and Machinery Co., East Liverpool, Ohio, has opened a new office in the Engineering Bldg., 205 W. Wacker Drive, Chicago, Ill. Robert E. Rullman, a mechanical engineer of recognized ability, has been appointed manager of the new office.

Remington Arms Co., Inc., New York City, has elected Charles E. Doyle to its board of directors, increasing the board to 15 members.

B. F. Goodrich Tire and Rubber Co., Akron, Ohio, according to newspapers reports, is to erect a \$1,000,000 rubber reclaiming factory at Gadsden, Ala., this summer. The new factory, 380 ft. long by 100 ft. front, will adjoin the large new Southern tire factory of the company now under construction. The Gadsden reclaiming plant is scheduled for a capacity of 25 tons of reclaimed rubber daily, most of which will be shipped to the Goodyear mechanical goods plant in Akron.

Bonney Forge & Tool Works, Allentown, Penn., has been singularly honored by the Daniel Guggenheim Fund for the Promotion of Aeronautics, due to its enterprise in placing a large airport identification arrow on the roof of the Bonney Bldg., which resulted in the city of Allentown being officially listed for airport identification on aviation maps. In recognition of this service a certificate of appreciation, bearing the signature of Harry F. Guggenheim and Col. Chas. A. Lindbergh of the Guggenheim Fund has been presented to the Bonney Company.

The American Hoist and Derrick Co., 63 South Robert St., St. Paul, manufacturers of the "American" line of locomotive cranes, "American Gopher" shovel-cranes and "American" hoists and derricks, announces the appointment of A. R. Gelinas as its agent for Ontario, Quebec and the Maritime Provinces. Mr. Gelinas' experience in the Canadian construction and industrial field fits him admirably to serve his many friends. Mr. Gelinas' office in Montreal is located in the McRitchie and Black Bldg., 1434 St. Catherine St. West, Montreal, Que., Canada.

Cutler-Hammer, Inc., Milwaukee, Wis., has made the following changes in personnel: P. S. Jones, formerly manager of the Pittsburgh office of the company, is now manager of the New York district office, succeeding C. W. Yerger, who left the company to accept a position with the Hanson-Van Winkle-Munning Co. T. S. Towle, formerly a sales engineer of the Pittsburgh office, becomes manager at Pittsburgh. G. E. Hunt has been placed in charge of distributors' sales. Mr. Hunt has been located in the Cutler-Hammer Philadelphia office for the past ten years.

Waukesha Motor Co., Waukesha, Wis., announces that H. A. Huebotter, formerly chief engineer of the Butler Manufacturing Co., Indianapolis, Ind., has joined the technical staff of their company. Mr. Huebotter has been engaged in both practical and theoretical research for a number of years. From the time of his graduation from Purdue University in 1912 he has devoted his energies to automotive research, design and production. He is a member of the Society of Automotive Engineers and is author of the book, "Mechanics of the Gasoline Engine."

General Electric Co., Schenectady, N. Y., announce that 28 employees have received awards of the Charles A. Coffin Foundation. The awards are bestowed annually in recognition of contributions toward the efficiency of the company or progress in electrical art. This is the sixth successive year they have been made by the Foundation, which is a perpetual memorial of Charles A. Coffin, first president of the company. The 28 awards were divided among seven engineers, six shop men, five expert mechanics, five foremen, four commercial employees and one administrative employee. Each man received a certificate and 8% bonds of the G-E Employees' Securities Corp.

The Cutler-Hammer Mfg. Co., Milwaukee, Wis., has changed its name to Cutler-Hammer, Inc., and has been reorganized as a Delaware corporation, with the following officers: F. R. Bacon, chairman of the board; B. L. Worden, president; F. L. Pierce and J. C. Wilson, vice-presidents; H. F. Vogt, treasurer, and W. C. Stevens, secretary. The board of directors is composed of F. R. Bacon, F. L. Pierce, B. L. Worden, Carl A. Johnson, T. Johnson Ward and L. A. Lecher. In the change from a Wisconsin to a Delaware corporation, the Cutler-Hammer Mfg. Co., the Cream City Foundry Co., both of Milwaukee, and the Cutler-Hammer Mfg. Co., New York, are united under one name.

The Prest-O-Lite Co., Inc., New York City, on January 1 acquired the business of the Acetylene Products Co., which operated two acetylene producing plants located respectively at 401 E. Buchanan St., Phoenix, Ariz., and at 914 Texas St., El Paso, Tex. Everett R. Kirland is superintendent of the Phoenix plant and Carl F. Chesak of the El Paso plant. R. G. Daggett, whose headquarters are at the San Francisco office, is district superintendent. Another new plant, the thirty-ninth in the company's chain of acetylene gas plants, located at 925 Hughes St., Houston, Tex., started operating February 2 and will supply dissolved acetylene for welding and cutting to local industry. A. J. Harrower is superintendent of the new plant, and H. F. Sutter, whose headquarters are at the Dallas plant, is district superintendent.

Trade Literature

NOTICE—Any publication mentioned under this heading will be sent free unless otherwise noted, to readers, on request to the firm issuing the publication. When writing for any of the items kindly mention ROCK PRODUCTS.

Air Heaters. New 12-page illustrated bulletin describing the company's "Thermix" air heaters for supplying heated air for drying, for preheating air for boilers and for similar uses. Includes photographs, diagrams and data on the transfer of heat, etc. PRAT-DANIEL CORP., New York City.

Slackline Excavators. Bulletin No. 58 describing the company's line of slackline excavators and hoists and illustrated with cuts of the equipment in use as well as pictures of the individual units. STREET BROS. MACHINE WORKS, Chattanooga, Tenn.

Bulk Cement Conveying. Bulletin describing the "Fuller Kinyon" conveying system for unloading bulk cement from railroad cars and depositing it in overhead storage bins at ready-mixed concrete plants and cement products plants. The folder is illustrated with pictures and drawing of various installations. FULLER CO., Catasauqua, Penn.

Engineering Achievement. A 24-page bulletin describing the outstanding developments and achievements of the company during 1928, with many illustrations. Includes announcement of developments in turbines, transformers, railway equipment, large and small motors, and many other branches. WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., East Pittsburgh, Penn.

Saving and Making Money. New 48-page bulletin describing "Rol-Man" woven manganese steel screens for crushing plants and sand and gravel operations, and providing data and pictures to show that such screens are more efficient and more economical. MANGANESE STEEL FORGE CO., Philadelphia, Penn.

Equipment for the Road Builder. Illustrated bulletin describing the company's compressors, air hammers, hoists, drills and similar equipment suitable for use by contractors and others in similar work. **Breaking Concrete. Bulletin No. 81-V** describing and illustrating the "K-2" buster for breaking concrete. **Rock Drills. Bulletin No. 81-S** describing the company's "Rotator" rock drills, containing 32 pages illustrated with pictures of the various drills, as well as views of the different units at work. SULLIVAN MACHINERY CO., Chicago.